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Empfohlene Zitierung / Suggested Citation:
Kunz, M. (2012). *Regional unemployment disparities in Germany: an empirical analysis of the determinants and adjustment paths on a small regional level.* (IAB-Bibliothek (Dissertationen), 331). Bielefeld: W. Bertelsmann Verlag. https://doi.org/10.3278/300762w

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https://nbn-resolving.org/urn:nbn:de:0168-ssoar-65276-2

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Bibliografische Information der Deutschen Nationalbibliothek

Die Deutsche Nationalbibliothek verzeichnet diese Publikation in der Deutschen Nationalbibliografie; detaillierte bibliografische Daten sind im Internet über http://dnb.ddb.de abrufbar.

Dissertation zur Erlangung des Grades eines Doktors der Wirtschaftswissenschaft eingereicht an der Wirtschaftswissenschaftlichen Fakultät der Universität Regensburg

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Tag der Disputation:	01.08.2011

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Herausgeber der Reihe IAB-Bibliothek: Institut für Arbeitsmarkt- und Berufsforschung der Bundesagentur für Arbeit (IAB), Regensburger Straße 104, 90478 Nürnberg, Telefon (09 11) 179-0 ■ **Redaktion:** Martina Dorsch, Institut für Arbeitsmarkt- und Berufsforschung der Bundesagentur für Arbeit, 90327 Nürnberg, Telefon (09 11) 179-32 06, E-Mail: martina.dorsch@iab.de ■ **Gesamtherstellung:** W. Bertelsmann Verlag, Bielefeld (wbv.de) ■ **Rechte:** Kein Teil dieses Werkes darf ohne vorherige Genehmigung des IAB in irgendeiner Form (unter Verwendung elektronischer Systeme oder als Ausdruck, Fotokopie oder Nutzung eines anderen Vervielfältigungsverfahrens) über den persönlichen Gebrauch hinaus verarbeitet oder verbreitet werden.

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ISBN 978-3-7639-4049-3 (Print)
ISBN 978-3-7639-4050-9 (E-Book)
ISBN-A 10.978.37639/40493
ISSN 1865-4096
Best.-Nr. 300762 www.iabshop.de www.iab.de

Contents

Figures		5
Tables		6
Danksagung		7
1	**Introduction**	9
2	**Theory and empirics of regional adjustment**	17
2.1	Geographical economics	18
2.1.1	The core model of geographical economics	18
2.1.2	Extensions of the core model	27
2.1.3	Economic geography and unemployment (disparities)	33
2.2	An alternative labour market model of regional adjustment	36
2.2.1	Theoretical framework	37
2.2.2	Reviewed papers – A technical discussion	39
2.2.3	Reviewed papers – Empirical results	42
2.2.3.1	Adjustment in the US	43
2.2.3.2	Adjustment in Europe and its candidate countries	44
2.2.3.3	Adjustment in single EU countries	45
2.2.3.4	Adjustment in Australasia	47
2.3	Conclusions from existing empirical work	49
3	**Disparities, persistence and dynamics of regional unemployment rates in Germany – an univariate analysis**	51
3.1	Theories of unemployment disparities	53
3.2	Regional data and methodological issues	55
3.3	A measure of relative unemployment	57
3.4	Disparities and persistence of unemployment rates	60
3.4.1	Disparities	61
3.4.2	Persistence	63
3.5	Unemployment dynamics	66
3.5.1	Convergence or divergence?	66
3.5.2	Adjustment to shocks	74
3.6	Conclusions of univariate models	79

4	**Unemployment dynamics in West Germany – a simultaneous approach**	81
4.1	A framework for regional evolutions	83
4.2	Regional Data	85
4.3	Migration and commuting activities in Germany	86
4.4	Empirical framework and district-specific data	91
4.5	Regional adjustment dynamics	94
4.5.1	Estimation results	95
4.6	Conclusions of simultaneous models	103
5	**Sources for regional unemployment disparities in Germany – a hybrid model**	105
5.1	The chain reaction theory of unemployment	107
5.2	National and regional data	110
5.3	Stationarity of national and regional variables	112
5.4	Results	114
5.4.1	Econometric specification and estimation results	114
5.4.2	Labour demand shocks	120
5.4.3	Exogenous shocks	124
5.5	Conclusions from the chain reaction theory	132
6	**Conclusion**	134
References		139
Appendix		145
Abstract		149
Kurzfassung		150

Figures

Figure 1: Development of regional employment offices unemployment rates 1959–2004 ... 10
Figure 2: Division of labour in the core model of geographical economics.... 20
Figure 3: Manufacturing share and relative real wage in the core model of geographical economics ... 23
Figure 4: Impact of transportation costs in the core model of geographical economics... 25
Figure 5: The core model of geographical economics as tomahawk diagram ... 26
Figure 6: The intermediate goods model with constant returns to scale ... 30
Figure 7: The intermediate goods model with decreasing returns to scale .. 32
Figure 8: The wage curve model with increasing returns to scale... 34
Figure 9: Spatial distribution of the cyclical sensitivity parameter... 59
Figure 10: Development of the German unemployment rate 1980–2004... 61
Figure 11: Unemployment rates across German districts 2004 ... 62
Figure 12: Persistence of regional unemployment rates (scatter) ... 64
Figure 13: Absolute and relative unemployment rates of regions... 73
Figure 14: Adjustment of regional unemployment ... 76
Figure 15: Development of Federal States Unemployment Rates 1980–2004.. 81
Figure 16: Netmigration, netcommuting and unemployment of districts in 2004 ... 87
Figure 17: Shares of immigrants and incommuters for districts in 2004 ... 89
Figure 18: Adjustment of employment, unemployment and participation to a labour demand shock (Place of Residence)... 98
Figure 19: Adjustment of employment, unemployment and participation to a labour demand shock (Place of Work) ... 100
Figure 20: Distribution of low, middle and high unemployment districts... 118
Figure 21: Actual and fitted unemployment rate of all, low, middle and high unemployment regions in the period 1994–2004 ... 119
Figure 22: Unemployment responses of all, low, middle and high unemployment regions to a shock in labour demand... 122
Figure 23: Total effect of regional variables at district level (1997–2001) ... 128
Figure 24: Total effect of regional variables at district level (2001–2004) ... 130

Tables

Table 1:	Reviewed articles	40
Table 2:	Main results of reviewed articles	43
Table 3:	Spearman rank correlation coefficients for absolute and relative unemployment rates in different periods	63
Table 4:	LLC and IPS tests for conditional convergence	70
Table 5:	Fixed-effects autoregressive model for unconditional convergence	72
Table 6:	Adjustment of regional unemployment	75
Table 7:	Mobility measures for districts and Federal States (average values) in 2004	90
Table 8:	Estimation coefficients of regional adjustment	96
Table 9:	Results for regional adjustment in Germany	102
Table 10:	Regional and National variables in the dataset	111
Table 11:	ADF test for stationarity of national variables	112
Table 12:	IPS and LLC test for stationarity of regional variables	113
Table 13:	Estimation Results for all districts	116
Table 14:	Short- and long-run effects of a labour demand shock in all, low, middle and high unemployment regions	123
Table 15:	Effects of exogenous shocks for boom and recession years	125

Danksagung

Die vorliegende Dissertation entstand während meiner Zeit als wissenschaftlicher Mitarbeiter und Stipendiat am Institut für Arbeitsmarkt- und Berufsforschung sowie in der darauf folgenden Zeit in den Zügen der Deutschen Bahn.

Ich danke Herrn Prof. Dr. Dr. h.c. Joachim Möller und Herrn Prof. Dr. Blien für die Möglichkeit zur Anfertigung dieser Arbeit an der Universität Regensburg bzw. am Forschungsbereich „Regionale Arbeitsmärkte" des Instituts für Arbeitsmarkt- und Berufsforschung. Bei beiden möchte ich mich ganz herzlich für die Übernahme der Betreuung, den gewährten Freiraum bei der Wahl der Thematik, der Gestaltung der Arbeit sowie für die Unterstützung und Beratung während der Erstellung bedanken.

Ein großes Dankeschön geht auch an die vielen Kollegen am Institut für Arbeitsmarkt- und Berufsforschung, die mir bei der Erstellung der einzelnen Teile der Arbeit mit wertvollen Kommentaren weitergeholfen haben. Ganz besonders möchte ich mich an dieser Stelle für die zahlreichen Diskussionen und treffenden Anmerkungen von Katja Wolf und Daniel Werner bedanken, die sich intensiv mit der Thematik auseinandergesetzt haben.

Meine Familie – ganz besonders meine Frau Nicola – hat mich stets angetrieben und ermuntert, die Arbeit nicht ruhen zu lassen. Auch die positive Energie durch meine beiden Söhne Moritz und Benjamin haben ihren Teil zu diesem Ergebnis beitragen. Ganz lieben Dank für Euere Unterstützung. Euch allen sei diese Arbeit gewidmet.

Marcus Kunz
Beratzhausen, im Januar 2012

1 Introduction

The development of regions and the disparities between them is a well-established and often discussed topic in the field of regional economics. One is likely to think that the huge amount of literature available in this research field should answer almost every question. Nevertheless, development and disparities seem to be an evergreen in regional economics and the topic is almost always up to date. In our opinion there are two main factors for this omnipresence:

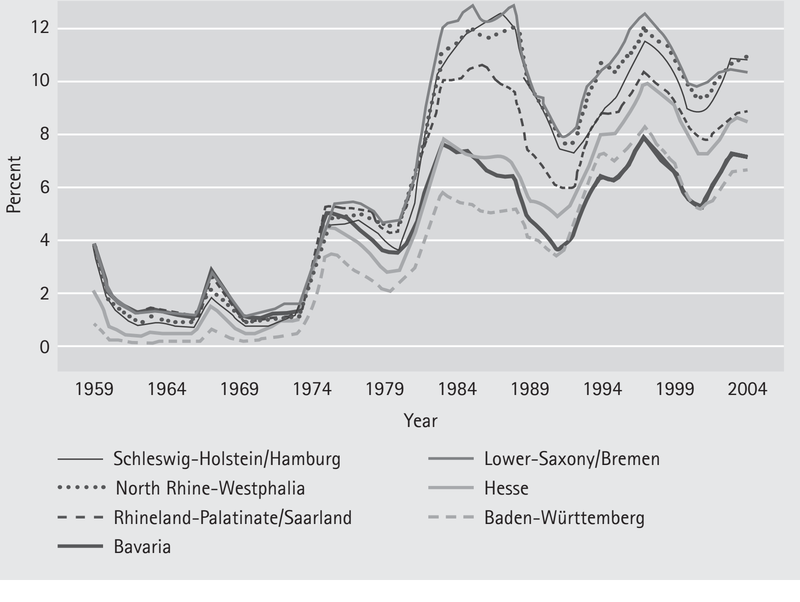
First, many political and economic decisions are at the same time regional decisions as they immediately affect the regional distribution of endowments and therefore the disparities between regions. The decision if e.g. an enterprise prefers region A, region B or still another region for a new establishment has major importance for all regions as the region where the enterprise settles improves its economic position compared to all other regions and all other regions deteriorate compared to the that region. The increasing competition of regions in widely open markets thus necessitates that regions rank among the best to appear attractive for new investments.

Second, despite the huge body of literature, the major questions concerning the development of regions and the disparities between them are not finally answered in the regional economics literature. Quite the contrary is the case: according to the traditional neoclassical literature introduced by Smith (1776), regional disparities should erode over time because of mobile production factors leading to a settlement of regional disparities. But, the empirical evidence and a growing body of literature following primarily the ideas of Myrdal (1957), Barro/Sala-i-Martin (1991) and Krugman (1991b) propose theories that lead to increasing instead of declining spatial disparities. Thus, empirical data as well as economic theory do not render a clear advice, how regional disparities develop and which political measures are adequate to remove them (if this is the political aim).

This observation holds for inter-country as well as for intra-country studies, i.e. studies on the regional development within a specific country. In Germany, several historical facts had a sustainable influence on the development of the national economy as well as the regional differences within Germany. The most obvious one was the German reunification in 1990 where the relatively rich and highly developed West German part unified with the relatively poor and underdeveloped East German part – a wealth and productivity gap that still exists today, more than 20 years later. Another far-reaching political decision marked the implementation of a common currency area – the Euro-Zone – in 2002, when 16 countries gave up their self-contained monetary policy to act under one monetary regime. A third major driving force for the change of the economic settings and therefore also highly relevant for the national and regional development was the increasing degree of globalisation. Each of these historical facts signified increasing integration of the national as well as the regional markets and therefore contributed to substantially higher factor mobility during the last decades. As described above, the effects of these radical changes for the development of the regional disparities within Germany are not clear.

One of the most important economic indicators in the context of labour market disparities is the unemployment rate. In many European countries and as well in Germany, the range of the regional unemployment rates within the country is enormous and even greater than between countries. In Germany, the unemployment rate at the level of regional employment offices (the operative structure of the Federal Employment Agency[1]) had a range between 3.3 and 11.3 percent in June 2011 and even a range between 1.2 and 17.3 percent at district level. Additionally, these sharp differences maintain over long periods of time.

Figure 1: Development of regional employment offices unemployment rates 1959–2004



Therefore, this paper empirically analyses regional unemployment disparities within Germany. Empirical research results for unemployment disparities within Germany are available, see e.g. Möller (1995), but, until now, several studies only focus on the relatively large federal states level (NUTS1) or on even larger units as labour

1 For a more detailed description of regional employment offices see section 3.2.

market areas. In this paper, the focus is instead on the development of the relatively small district level (NUTS3) where disparities are even more distinct. If it appears to be necessary and adequate, estimation results are additionally provided for federal states or regional employment offices and then compared to the results found for districts.

To motivate our key questions outlined below, Figure 1 shows the unemployment rates of regional employment offices in West Germany for the period 1959–2004.

Figure 1 impressively shows the dramatic rise of the German unemployment rate during the 4 ½ decades from 1959–2004. The rapid increase during recession and decrease during boom periods suggests that regional unemployment rates react sensitively to exogenous shocks. As the development of the unemployment rates is additionally quite synchronous, the reaction seems to be driven predominantly by nation wide shocks. Especially in the aftermath of the oil price shocks in 1973 and 1980, the unemployment rate across regional employment offices rose excursively within only two to three years and amounted to about two to three times the level than before those shocks. Contemporaneously, the spread of the unemployment rates across the regional employment offices also rose in the aftermath of those shocks: in the years from 1973–1975 the spread of the unemployment rates across regional employment offices rose from 1.2 to 1.9 percentage points and in the years 1980–1983 even from 2.4 to 6.3 percentage points. Remarkably, the spread across regional employment offices still rose in the following years, i.e. from 1976–1979 and from 1984–1988, although the national unemployment rate had already stabilised around the new "after-shock" level. This development was due to the fact that the unemployment rate of northern German regional employment offices – i.e. those regional employment offices with already high unemployment – still increased or decreased only little, whereas the unemployment rates of southern German regional employment offices already decreased directly from the period after the shock. Afterwards, all regional unemployment offices showed declining unemployment rates as well as a quite stable spread of unemployment rates until 1988. In the boom period of the German Reunification from 1988–1991 the unemployment rates of regional employment offices as well as the spread of the distribution fell sharply. The range of regional unemployment rates thereby decreased from 7.7 to 4.5 percentage points. Since 1992 those unemployment disparities remained remarkably stable: the spread of regional unemployment rates only varied from 3.9 to 4.9 percentage points although the regional unemployment rates passed through a complete business cycle, i.e. an upswing and a downswing period.

These observations lead us to the formulation of three stylised facts: first, exogenous shocks lead to a rising spread in the distribution of unemployment rates and tend to have additional aftereffects on the unemployment rate, especially in high unemployment regions. Those disparities remain stable in the aftermath of a shock, i.e. the unemployment rates do not converge again towards the national unemployment rate. Second, the unemployment rates of regions react quite sensitive to exogenous shocks and therefore seem to be a major adjustment mechanism for regions. Thus, the unemployment rate deals as a labour force buffer where additional employment during boom years is taken from the pool of unemployed and pushed back to unemployment in recession years. Third, as regional unemployment rates develop quite synchronous in boom and recession periods, nationwide shocks seem to be the major driving forces for the development of regional unemployment rates.

According to these stylized facts, three key questions in the context of regional unemployment disparities that should be answered in this paper are at hand:

Question 1: Does the distribution of regional unemployment rates in West Germany converge towards a persistent configuration of unemployment disparities or even towards the aggregate unemployment rate in the aftermath a shock?
According to the literature, unemployment differentials arise because of different regional endowments of factors and/or imperfect labour market adjustment mechanisms. According to these two core properties the different approaches can be characterized as follows:

Equilibrium based models concentrate on equilibrium explanations and use theoretical long-run relationships between unemployment and other variables like job vacancies (Beveridge Curve), the national unemployment rate (Cyclical Sensitivity model) or regional amenities (Amenity model) to investigate differences in regional unemployment. Other models of the equilibrium type as migration- or wage-setting-curve- (Phillips-Curve) based approaches use theoretical explanations, where the unemployment rate is not directly estimated, but can be calculated out of these relationships. A further equilibrium approach is to use the labour market accounting identity: the labour market can be characterized by one equation, the labour market identity, where unemployment results out of the difference between labour supply and labour demand. Commonly, the different parts of the identity characterising labour demand (employment) and labour supply (working age population, participation rate or commuters) are replaced by their theoretical functions.

The problem that arises in all equilibrium approaches is that the labour market is not in its equilibrium for most of the time, if ever: adjustment processes in the aftermath of exogenous shocks may last for several years and thus superimpose or even distort the estimated long-run relationship. Therefore, another approach is to allow for dynamical relationships where adjustment processes after the occurrence of shocks are traced until a new equilibrium has established and to evaluate the degree of persistence in the relevant labour market variables. This kind of models also impose a long-run relationship, but temporary shocks lead to a fluctuation around this relationship and adjustment mechanisms force the labour market back towards this relationship. Only if the adjustment mechanisms are not well working, shocks may have permanent effects and lead to the establishment of a new long-run equilibrium. In those models, an initial shock may have different effects on the long-run equilibrium: a shock may not have an effect on the long-run equilibrium and all variables turn back to their initial steady state if the shock has settled or a shock may have a permanent effect on the long-run equilibrium and some or all variables do not turn back to their steady state, even if the shock has settled. The second phenomenon is known as hysteresis. The advantages of this approach are that these models deal only indirectly with the influence of exogenous variables and the difficult selection of possible sources for unemployment disparities as well as the problem of labour markets away from their equilibrium does not apply. Exogenous shocks are instead directly modelled by changes in the endogenous variables: the entrance of a new company that induces a raise in vacancies or exogenous changes in the attractiveness of a region by whatever reason may for example be represented by a positive shock in labour demand. Thus, most models that allow for hysteresis do not explicitly show which exogenous variables influence the unemployment rate but instead show the influence of any labour market to shock (i.e. a shock in labour demand, labour supply or wages) to all labour market variables. We will outline hysteresis approaches and their properties more detailed in the theoretical as well as empirical part of the paper.

Question 2: How do regions and districts adjust in the aftermath of a regional labour market shock?

If a region experiences a labour demand shock it must adjust in one way or another. Regional adjustment in the aftermath of a shock may work through different quantity or price adjustments. Simple models of regional adjustment with two open economies that experience wage differences because of different regional amenities (compensating differentials) present quite clear cut thoughts about these possible adjustment channels. In fact, the complete adjustment process of an economy that experiences a shock can be characterised by changes in only a few variables, i.e.:

(1) Changes in the labour demand (i.e. job creation or destruction) of existing firms: If the demand for a special good that is produced locally rises externally, locally existing firms may create new jobs to be able to serve the additional demand for

their product. On the other hand, a negative demand shock for a special regional product, e.g. through the invention of a new, better substitute in another part of the world, might force a local existing firm to lower its labour demand by dismissals.

(2) Migration of firms: a positive labour supply shock in a region could attract firms from other regions e.g. to take advantage of an enlarged pool of motivated workers. A negative shock instead may force existing firms to leave a region, e.g. due to a lack of qualified workers (who also leave the region).

(3) Changes in the labour market participation: in the case of a positive shock to labour demand, the additional job offers will help unemployed to get employed. Thus, the regional unemployment rate should decrease, whereas the regional employment rate should increase. The regional participation rate (defined as sum of employed and unemployed divided by the working-age-population) itself should also rise as people outside the labour force will re-enter into a tight labour market. Conversely, in the case of a negative shock, the unemployment rate should increase, the employment rate should decrease and the participation rate should also decrease because some formerly unemployed who remain in the region will get "discouraged" and drop out of the labour force.

(4) Migration of workers: similarly to the migration of firms, a positive labour market shock will attract workers from other regions because of better job opportunities. In the case of a negative shock, some workers will leave and look for jobs in other regions with better labour market conditions. As a special case of worker migration we will also investigate commuting, where people also move to their place of work but do not change their place of residence.

(5) Adjustments in wages: the adjustment of the labour market might also take place by a price adjustment, i.e. an adjustment of wages. In the case of a positive labour market shock, wages should increase in order to attract new workers or to compensate already employed persons for extra work. In the case of a negative labour market shock, wages should decrease because of the shrinking bargaining power of employed or because of temporary short-time work.

The assumptions of these simple models are well applicable in the case of regions or districts, which can be seen as small open economies. Thus, a well working labour market should be able to adjust via intraregional quantity adjustments (variables (1) + (3)), interregional quantity adjustments (variables (2) + (4)) or price adjustments (variable (5)). In fact, these adjustment mechanisms do not foreclose each other, i.e. adjustment should not only work via one of these mechanisms. Quite the contrary is the case and regional adjustment should work through all of these mechanisms simultaneously. Especially the adjustment via wages should reinforce the four quantity adjustments: a positive labour market shock where existing firms raise their job offers and new firms establish will increase wages and should in turn attract new workers and raise the participation rate. A negative labour market shock with shrinking job offers through the emigration of firms or dismissals of existing firms should lower wages and go along with the emigration of workers and a decreasing labour force participation rate. The question is rather, how much of the adjustment process can be attributed to which of these mechanism.

A large part of the empirical analysis deals with the question what happens in a region after a positive labour demand shock. Thereby, we already assume that existing or new firms offer additional jobs in the aftermath of positive labour market shock, i.e. we do not observe a difference between adjustment mechanism (1) and (2). Therefore, we do not take a closer look at the question who offers those jobs, although this would also be an interesting and important question. We also do not investigate the adjustment of wages as our prior interest is the development of the unemployment rate. Thus, we focus exclusively on the quantity adjustment of labour, i.e. changes in the labour market participation – with the unemployment rate as one form of participation – and interregional migration/ commuting. The aim of this investigation is to gain a more detailed picture of who accesses a job if a small region as a district succeeds in offering new jobs. Are new jobs filled predominantly by unemployed? Or by people entering the labour force, i.e. by formerly non-active people in the working-age-population? Does substantial migration set in? Or is a major part filled by commuters who are situated around a prosperous region? These questions should play an important role for the strategic behaviour of local politicians as well as for the whole labour market administration of a country.

Question 3: What are the sources for regional unemployment disparities observed in West Germany?

Our last key question deals with the sources of regional unemployment disparities and tries to measure both, the effect of exogenous shocks as well as the effect of lagged adjustment mechanisms on the regional unemployment rate. In contrast to our first key question, we do not only focus on the differentiation between equilibrium or hysteresis behaviour of the unemployment rate. Additionally, we try to separate these effects to see if movements in the regional unemployment rates are driven by changes in the underlying exogenous variables on the one hand, lagged adjustment of (endogenous) labour market variables on the other hand or if both, structural changes as well as lagged adjustment mechanisms are relevant to explain regional disparities in the unemployment rate. As we employ regional as well as national exogenous variables in our empirical approach, we are additionally able to separate the effects of national versus regional shocks.

The three key questions posed above are sequentially answered in the empirical part of the paper: section 3 generally deals with the question if the unemployment rates across districts and regions within Germany show convergence or if regional differences tend to increase and therefore tries to answer question 1. Section 4 focuses on key question 2 and sheds light on the adjustment process at work for different variables after a labour demand shock occurs. In the final empirical section 5, a model which is able to separate the effects of exogenous variables from lagged adjustment processes is presented to answer key question 3. Before, the first part of the following section will give an overview of the latest theoretical developments in geographical economics and their relevance for the existence of regional unemployment disparities. As the implications of those models can hardly be tested empirically, we present an alternative approach to answer these questions in the second part of section 2.

2 Theory and empirics of regional adjustment

The explanation of different geographical patterns found for different economic variables between and within countries has a long tradition in economics. Already very early works by von Thuenen (1826), Launhardt (1885), Weber (1909), Christaller (1933) or Loesch (1940) – the grounding fathers of regional economics – try to explain different aspects of the location of economic activity across an economy. Their approaches are mainly driven by directly modelling a spatial structure without taking into account the behaviour of economic agents like firms or individuals and thus lack a microeconomic foundation. Other fields of economic theory also deal with the distribution of economic patterns across space. The neoclassical trade theory based on ideas of Ricardo (1817), Ohlin (1933) and Samuelson (1952) aims at explaining patterns in the specialization of production of countries. In contrast to regional economics it has a strong microeconomic foundation, but, in most parts, ignores the spatial structure. The development of the new trade theory initiated by Krugman (1979, 1980) and further developed in Krugman/Venables (1990) added some important insights as the explanation of intra-industry trade or the "home-market effect" by the introduction of consumers "love-of-variety" and transportation costs to the neoclassical trade theory. Nevertheless, it still ignores crucial geographical aspects as firms and workers are immobile and location decisions or the market size are modelled as external economies of scale and are thus determined outside the model.

Another strand of economic theory that becomes relevant in a discussion of dispersed spatial structures refers to economic growth. In the neoclassical growth theory originated by Solow (1956), technological progress is the only means to generate economic growth in the long-run. As the theory assumes that countries are equal in all structural and institutional aspects and have access to the same technology, the neoclassical model predicts that differences in economic growth rates across regions and countries are transitory and will converge towards the same level of economic growth in all countries, i.e. the neoclassical growth model predicts absolute convergence of output per capita. There are two possibilities in the literature to correct the neoclassical growth model in this aspect: one approach is the introduction of location-specific differences in the technology or the structural and institutional settings that lead to conditional rather than absolute convergence and therefore allow for different, location-specific growth rates. The second and more acknowledged attempt is called new growth theory and was initiated by the works of Romer (1986) and Lucas (1988). They introduce external economies of scale or avoid diminishing returns to accumulable factors to enable the possibility of core-peripheral spatial structures. In the end, both approaches still ignore the decision how those externalities localize and thus the localization of external factors is still not endogenous to the model.

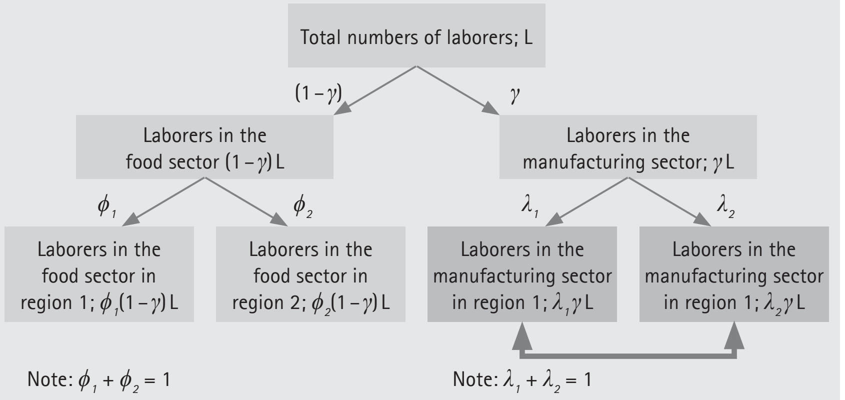
2.1 Geographical economics

Thus, different strands of economic literature deal more or less intensively with geographical structures and standard microeconomic theory. As Brakman/Garretsen/Marrewijk (2009) put it, all those approaches have something useful to say on the relationship between geography and economics, but each approach has also its limitations. In his article of 1991a, Krugman proposed a model that constitutes a synthesis of the new trade theory and the new growth theory that additionally has the desired feature to determine the location decision of economic agents within the model. Thus, this approach offers both, a sound microeconomic foundation and the endogeneity of location decisions of labour demand (firms) and labour supply (people). Presumably this is the reason, why the article by Krugman (1991a) attended so much attention among regional scientists and even founded a new field in economics – the new economic geography. Brakman/Garretsen/Marrewijk (2009) argue that the new economic geography – as well as many other approaches as urban or regional economics – is in the first place an attempt to bring more geography into economics. Therefore they propose the terminology "geographical economics" rather than "new economic geography". We follow Brakman/Garretsen/Marrewijk (2009) in this notational issue and use the terminology geographical economics instead of new economic geography. The description of the core model of geographical economics in section 2.1.1 as well as the most important extensions of the core model outlined in section 2.1.2 is based on Brakman/Garretsen/Marrewijk (2009).

2.1.1 The core model of geographical economics

The core model of geographical economics is a two-region two-sector model. Each of the two regions has an agricultural and a manufacturing sector. Consumers in both regions consist of agricultural (farm) workers and manufacturing workers. Agricultural workers get their income through the work on their farms (in each region there are as many farms as workers). By assumption, they are completely immobile in both, regions as well as sectors, i.e. they can neither move from one region to the other, nor from agriculture to manufacturing. Manufacturing workers get their income from work in manufacturing firms in their home region. Manufacturing workers are also immobile between sectors, but, differently to agricultural workers, they are allowed to move between regions. There are N_1 manufacturing firms in region 1 and N_2 manufacturing firms in region 2. Each manufacturing firms produces a differentiated product, i.e. the product is a unique variety of manufactures. Manufacturing firms use labour as sole input factor in their production process. The production process itself is characterized by internal economies of scale, i.e. a firm denotes decreasing average costs for each additional unit of its output. As each firm produces a unique variety of manufactures, this setting implies monopolistic power for each firm which it uses in its price setting, see Dixit/Stiglitz (1977) for the model with monopolistic competition. If a firm sells manufactures in its home region, there are no transport costs. If a firm instead sells a product in the other region, positive transport costs are assumed. In the core model, transport costs are modelled as iceberg costs as introduced by Samuelson (1952). The idea is that transport is costly in the sense that not all goods arrive at the destination if sent from one place to another. Thus, iceberg transportation costs, T, are defined as the number of goods that have to be sent so that one unit of the respective good arrives at the destination. Therefore, the price of the same manufacturing variety is lower in the home region compared to the foreign region. Consumers spend their income on food and manufactures. Since food is a homogenous good and transport costs for food are assumed to be zero, the price for food and therefore also the agricultural wage rate (the income of farmers) is the same in both regions. The spending of consumers on manufacturing goods however has to be separated on a number of domestic and foreign manufactures. As consumers have to pay the transport costs, foreign varieties of manufactures are more expensive than domestic manufactures. But, as consumers have a love for variety, they always consume at least some units of all varieties, i.e. domestic as well as foreign products. As mentioned above, the labour force in the two-region two-sector economy is subdivided into agricultural workers and manufacturing workers. In the core model of geographical economics, the share of manufacturing workers amounts to γ. Thus, a share of $1-\gamma$ of the labour force works in the agricultural sector. A fraction ϕ_1 of all agricultural workers ($1-\gamma$) and a fraction of λ_i of all manufacturing workers (γ) is located in region i. Thus, the divison of labour in the economy is as depicted in Figure 2:

Figure 2: Division of labour in the core model of geographical economics



Source: Brakman/Garretsen/Marrewijk (2009) p. 138.

Given the total labour force *L*, agricultural workers in region *i* amount to $\phi_i(1-\lambda)L$ and manufacturing workers in region *i* amount to $\lambda_i \gamma L$. The shaded boxes of manufacturing workers in both regions concern the construction of mobility in the model: different from agricultural workers, manufacturing workers are allowed to move between regions but only within the manufacturing sector. Note therefore that both, the share of agricultural as well as the share of manufacturing workers is fixed within this framework.

This is the general setup for the core model of geographical economics with which the demand side, the supply side and the equilibrium can be determined.[2] In the context of the geographical economics approach we are especially interested in the distribution of labour and firms as well as in the dynamics of the system. Therefore, in a first step, we derive the short-run equilibrium for an exogenously given distribution of workers in a two-region two-sector framework in the presence of labour immobility. The second step is then to analyse the dynamics of the system, i.e. changes in the short-run equilibrium if labour is allowed to move between locations which finally ends up in the long-run equilibrium if movements have settled.

The short-run equilibrium is characterised by immobile workers – even in the manufacturing sector. Additionally it is assumed, that labour markets clear, i.e. all farmers and manufacturing workers have a job. Then, the short-run equilibrium can be determined by analyzing the demand side and the supply side of the model. We first turn to the demand side.

2 For a detailed analytical derivation of the demand side, the supply side and the equilibrium see Brakman/Garretsen/Marrewijk (2009).

If there are $\phi_i(1-\lambda)L$ agricultural workers, each earning a wage of one and $\lambda_i \gamma L$ manufacturing workers, each earning a wage rate of W_1 in region 1, the total income Y_1 generated in region 1 amounts to

$$Y_1 = \lambda_1 W_1 \gamma L + \phi_1 (1-\gamma) L \qquad \textbf{(1)}$$

as labour is the only income source. As the price a firm charges depends on both, the location of the firm (as this determines the wage rate, the firm has to pay to its workers) and the location of the consumer (as this determines whether the consumer has to pay transport costs or not), the price index of manufactures will differ between regions. Given the transport costs, the different prices for a variety of a firm situated in region 1 (for consumers situated in region 1 as well as for a consumer situated in region 2) and the number of firms located in region 1, the price index for manufactures in region 1 can be calculated as

$$I_1 = \left(\frac{\beta}{\rho}\right)\left(\frac{\gamma L}{\alpha\varepsilon}\right)^{1/1-\varepsilon} \left[\lambda_1 W_1^{1-\varepsilon} + \lambda_2 T^{1-\varepsilon} W_2^{1-\varepsilon}\right]^{1/1-\varepsilon} \qquad \textbf{(2)}$$

where α are the fixed costs and β the marginal costs for producing one unit of a variety, ε is the elasticity of demand and ρ represents consumers love-of-variety. Thus, the price index in region 1 is essentially a weighted average of the price of local goods produced in region 1 and the price of imported goods produced in region 2.

The total income and the price index of manufactures in region 2 can be calculated analogously. If we additionally use the relationship for the price of the variety in region 1 (the home region), $p_1 = \beta W_1/\rho$, and the price of the variety in region 2, $p_1 = T\beta W_1/\rho$, the total demand for a producer of a variety in region 1, x_1, is given by the sum of the demand in region 1 and region 2 and equals

$$x_1 = (\delta\beta^{-\varepsilon}\rho^{\varepsilon})(Y_1 W_1^{-\varepsilon} I_1^{\varepsilon-1} + Y_2 W_1^{-\varepsilon} T^{-\varepsilon} I_2^{\varepsilon-1}) \qquad \textbf{(3)}$$

where δ represents the share of income spent on manufactures. Thus, the demand for a variety in a region depends among others on the wage rate of manufacturing workers in this region, the income and the manufactures price index in both regions and the transport costs.

If we set the firms aggregate output level equal to total demand equation (3) and consider transportation costs between the regions we are able to calculate the equilibrium price of a variety. If this relationship is solved for the wage rate in region 1, we obtain

$$W_1 = \rho\beta^{-\rho}\left(\frac{\delta}{(\varepsilon - 1)\alpha}\right)^{1/\varepsilon}\left[Y_1 I_1^{\varepsilon-1} + Y_2 T^{1-\varepsilon} I_2^{\varepsilon-1}\right]^{1/\varepsilon} \qquad \textbf{(4)}$$

Equation (4) states that wages in a region are the higher, the closer it is located to large markets. Thus, the higher the total income in the other region and the smaller the transportation costs (i.e. the distance) to this market, the higher the wage of a worker in a firm located in a specific region.

Note that the short-run equilibrium for region 1 given in equations (1), (3) and (4) shows a great resemblance with gravity models and models of the market potential approach as the attractiveness of a region is related to the purchasing power in and the distance to the other region. Equations (1), (3) and (4) can also be derived for region 2 giving a total of 6 nonlinear equations in the core model of geographical economics. This solution generally holds also for more than two regions. In this case, the short-run equilibrium wage rate of each region depends on the market size of and the distance to all other regions which is a very attractive property.

In the short-run equilibrium, manufacturing workers were assumed to be immobile. In the long-run, this assumption is not plausible as workers move between regions if they can earn more in the other region. As not the nominal wage, but the real wage is relevant for the workers decision to move, the long-run equilibrium can be characterised by an additional equation for the real wage rate

$$w_1 = W_1 I_1^{-\delta} \qquad \textbf{(5)}$$

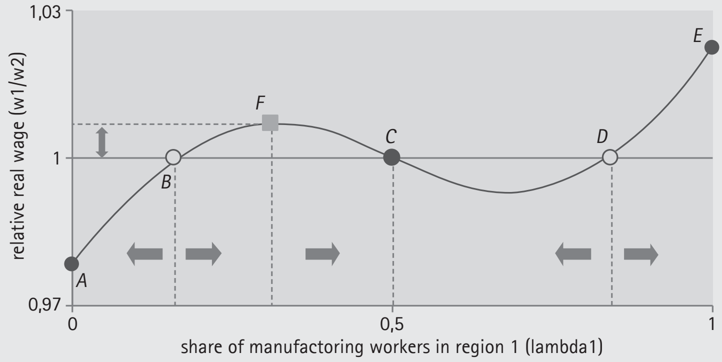
The real wage rate can thus be calculated from the nominal wage deflated with the manufacturers price index which is weighted by the share of income spent on manufacturing varieties. In the long-run equilibrium, the real wage rates between regions must be equal, so that $w_1 = w_2$.

The equilibrium equations (1), (3) and (4) also apply for the case or R regions, but, as the case for $R = 2$ regions with 6 non-linear equations is difficult enough, we present the results only for the two region case. As our prior interest is to learn how the core model reacts to changes in the parameter setting, we use simulation techniques to show the influence of variations of the most interesting parameters on the equilibrium. Our interest especially concentrates on the geographic distribution of the manufacturing work force and its dynamics. Therefore we do not fix this distribution but set $\lambda_1 + \lambda_2 = 1 = \gamma L$. Recall that several parameters and variables in the core model are a-priori unknown. Therefore, we first have to specify values for the exogenous parameters γ, δ, ε, ϕ_r and the transport costs between region r and s, T_{rs} to enable us the calculation of the endogenous variables Y_r, I_r and W_r.

In the specification of these parameters we follow Brakman/Garretsen/Marrewijk (2009). They chose the values of the parameters δ and ε on the basis of empirical research. The share of income spent on manufactures, δ, is chosen fairly low at a value of 0.4, the substitution parameter $\varepsilon = 1/1(1-\rho)$ is instead chosen quite high at a value of 5 ($\rho = 0.8$). The fraction of the immobile agricultural workers is assumed to be equally distributed across both regions at $\phi_1 = \phi_2 = 0.5$. The total labour force amounts to 1. As we focus on the two region case, $T_{rs} = T^{D_{rs}}$ becomes T for $D^{rs} = 1$. The value for the parameter T is also chosen fairly high at a value of 1.7 to show some of the important features of the core model of geographical economics. Note that this setting implies that both regions are identical with respect to all parameters. The only parameter that is able to vary is the share of manufacturing workers, λ, in each region.

To explicitly show the influence of variations in the manufacturing work force on other variables and to show the possible resulting equilibria, λ_1 is gradually increased within the interval from zero to one. For each value of λ_1 the resulting equilibrium values for the endogenous variables Y_r, I_r and W_r in both regions and the respective relative real wage, i.e. w_1/w_2 is then calculated by sequential iterations.[3] By doing this, we consider all possibilities in the allocation of the mobile work force between region 1 and region 2 (recall that $\lambda_1 + \lambda_2 = 1$) and are therefore able to investigate all possible short-run equilibria. If we additionally consider the relative real wage, we are also able to check for the stability of these equilibria and can study the dynamics of the system. The result for the share of the manufacturing work force in region 1 and the respective relative real wage are plotted in Figure 3:

Figure 3: Manufacturing share and relative real wage in the core model of geographical economics



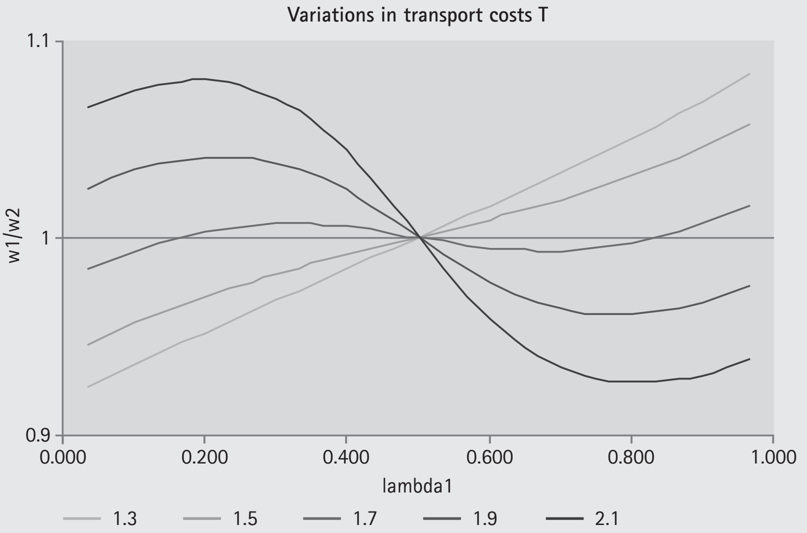
Source: Brakman/Garretsen/Marrewijk (2009) p. 166.

3 Brakman/Garretsen/Marrewijk (2009) use a stopping criterion defined as the relative change of the nominal wage from one to the next iteration in each region. The iterative search of the equilibrium values stops if the stopping criterion is lower than a critical value of 0.0001 in both regions.

The curve in Figure 3 represents all possible short-run equilibria for the allocation of the mobile labour force between region 1 and 2. As we argued that a long-run equilibrium is characterised by identical real wages, a possible long-run equilibrium affords $w_1/w_2 = 1$. This reduces the number of possible long-run equilibria to five, depicted as points A–E in Figure 3. For all other possible short-run equilibria where $w_1/w_2 \neq 1$, mobile workers have an incentive to move to the region with the higher real wage. In point F for example, $w_1 > w_2$ ensures that manufacturing workers will move to region 1. This will continue until real wages in both regions are equal, i.e. the long-run equilibrium in point C is reached. If the same reflection is done for all possible short-run equilibria, we can derive the "basin of attraction" for each long-run equilibrium, characterised by the arrows in Figure 3. All allocations of the mobile work force below a λ_1 of point B will finally result in a complete concentration in region 2. Symmetrically, all allocations of the mobile work force above a λ_1 of point E will finally result in a complete concentration in region 2. In the case of short-run equilibria resulting between the points B and D, a long-run equilibrium that is characterised by spreading of the manufacturing workforce, i.e. the manufacturing workforce is allocated equally in region 1 and region 2, will establish. Note that the relationship $w_1 = w_2$ is no more necessary if the total mobile workforce concentrates in region 1 or region 2. The points B and D are two further long-run equilibria where the mobile work force is partially concentrated in one of the two regions. In point B, the larger part of all manufacturing workers is located in region 2 whereas in point D, the larger part of all manufacturing workers is located in region 1. Nevertheless, points B and D are different from points A, C and E as they do not have a basin of attraction. Thus, only a little disturbance in the system resulting in a point on the left or the right of points B or D, lead to a full concentration of the mobile work force in A or E or to an equally allocated mobile work force in point C. The long-run equilibria B and D are therefore called unstable and the long-run equilibria A, C and E are stable. Points B and D are therefore marked as open circles in Figure 3.

As mentioned above, transport costs were chosen at a fairly high level of 1.7 in the simulations above. Transport costs may however cover not only the price to move a unit of a good from one place to another. One could also imagine that differences in the language, the cultural heritage or tariffs also influence transportation costs. As transportation costs are therefore an important feature in the model as well as in the real economy, the next question we seek to answer is how changes in the transport costs affect the distribution of short- and long-run equilibria. Figure 4 therefore shows possible equilibrium constellations for different transportation costs keeping all other assumptions met above unchanged.

Figure 4: Impact of transportation costs in the core model of geographical economics

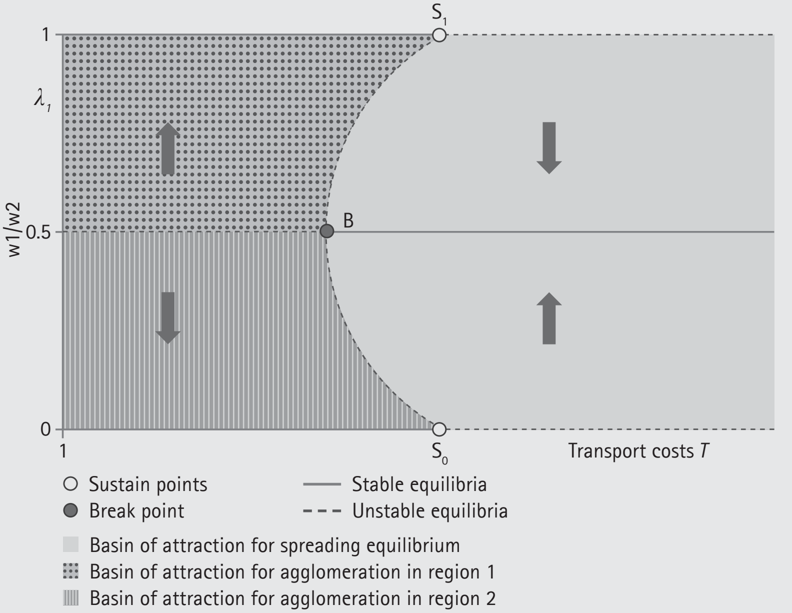


Source: Brakman/Garretsen/Marrewijk (2009) p. 168.

What we see in Figure 4 is that high transportation costs of 1.9 or 2.1 lead to a spreading of the work force. As the relative real wage of 1 is crossed only once over the whole interval of λ_1, the spreading equilibrium is also stable. Thus for high transportation costs the mobile work force is equally allocated across both regions for the given parameter setting. For low transportation costs of 1.3 or 1.5 on the other hand, the spreading equilibrium is unstable but the agglomeration equilibria are stable. The basin of attraction for region 1 is in the interval of λ_1 between 0.5 and 1 and the basin of attraction for region 2 is in the interval of λ_1 between 0 and 0.5. Thus, for low transportation costs the mobile work force will concentrate on only one of the two possible locations. Both results make sense intuitively: in the case of high transportation costs it is more efficient to produce and provide manufactures locally as it is too costly to distribute manufactures between regions. In the case of low transportation costs manufactures are produced only in one region as the other region with its immobile agricultural workers can be provided from the distance with only low costs. Only in the special case of moderate transportation costs of 1.7, both, spreading as well as agglomeration equilibria are possible as a relative real wage of 1 is reached several times for different values of λ_1.

It is illustrative to look at the relationship between the manufacturing share in region 1, λ_1, and transport costs from a different point of view. Figure 5 displays this relationship:

Figure 5: The core model of geographical economics as tomahawk diagram



Source: Brakman/Garretsen/Marrewijk (2009) p. 170.

The so-called tomahawk diagram of the core model of geographical economics shows all stable and unstable equilibria for several values of transport costs. As already derived from Figure 4, high transport costs always lead to a spreading equilibrium, depicted as arrows showing towards the solid horizontal line at $\lambda_1 = 0.5$ in Figure 5. Low transport costs on the other hand always lead to a full agglomeration of the mobile work force in region 1 or 2, depending on the initial distribution of manufacturing workers. If more mobile workers are located in region 1 initially, all manufacturing workers will finally end up in region 1. Exactly the reverse happens if more mobile workers are initially located in region 2. This mechanism is depicted as arrows showing towards the upper and lower edge of the tomahawk diagram. Thus, stable agglomeration equilibria result for low transport costs in a range from 1 to S_0/S_1 and stable spreading equilibria result for high transport costs until a value of *B*. If the transport costs are in a medium range between *B* and S_0/S_1, additional unstable equilibria already known from Figure 3 might arise. From the simulations for different values of transportation costs in Figure 4 we can se that these unstable equilibria move closer to the spreading equilibrium if *T* becomes lower and move closer to the agglomeration equilibrium if *T* becomes larger resulting in the "tomahawk"-curve connecting the points S_0, *B* and S_1.

The analysis shows that there are 3 large basins of attraction. One for total agglomeration in region 1 marked as dotted area, one for total agglomeration in region 2 marked as striped area and one for a spreading equilibrium marked as blank area. This analysis also shows that the unstable equilibria and especially the points S_0, S_1 and *B* are very special cases. The points S_0 and S_1 are called sustain points and the point *B* is called break point. As shown in Fujita/Krugman/Venables (1999) spreading equilibria only occur if $\rho > \delta$. Otherwise, forces towards full agglomeration would always prevail and the economy would tend to collapse into a point. They therefore label the condition $\rho > \delta$ the "no-black-hole" condition. If the no-black-hole condition is met, full agglomeration in the sustain points is sustainable only for sufficiently small transport costs. For large transport costs, the hypothetical real wages in the region without manufacturing workers would exceed unity and give manufacturing workers in the agglomerated region an incentive to move to the other region. Therefore, the sustain points are not sustainable for sufficiently large transport costs. The break point *B* marks the threshold for the stable spreading equilibrium. If the no-black-hole condition is met, the spreading equilibrium is only stable for sufficiently high transport costs. As one can see from Figure 5, there is a small range of transport costs between the break point *B* and the sustain points S_0/S_1 where each type of equilibrium is possible, i.e. unstable as well as stable spreading or agglomeration equilibria might occur. This brings us to the concept of path dependency (also called hysteresis) introduced in Fujita/Krugman/Venables (1999) which stats that history matters. If, e.g. transport costs initially are large, the economy will end up in a spreading equilibrium. Suppose, the transport costs decrease for some reason, e.g. to a level of 1.7. Then, the economy remains in a spreading equilibrium. If the transport costs further decrease below a certain threshold value (the break point), the spreading equilibrium becomes unstable and the economy will concentrate in one of the two regions, but we are not able to predict in which region. Suppose that full agglomeration took place in region 1. Now suppose that the transport costs start rising again by some reason, e.g. until a value of 1.7. Then the economy remains in an agglomeration equilibrium. So, for the same value of transport costs (e.g. 1.7), different equilibria might emerge, dependent on the former level of transport costs, i.e. history matters as the equilibria are path dependent. Only if the transport costs exceed a further threshold value (the sustain point), a new spreading equilibrium emerges.

2.1.2 Extensions of the core model

In the core model of geographical economics, labour mobility is the only way to explain the agglomeration of economic activity. Given that transport costs are low and will not increase, full agglomeration will be the stable outcome of economic activity forever. This is a rather extreme situation that can hardly be observed in the real world. Furthermore, interregional labour mobility is rather low within countries and even absent between countries, which also contrasts the prediction of full agglomeration in the core model. Therefore the core model has been extended for other driving forces. One extension is to allow for intermediate inputs in the production process, i.e. some firms produce intermediate products that are used as inputs for final products by other firms. As in the core model, each consumer demands each variety of intermediate as well as final products. Additionally, it is assumed that each firm uses each intermediate good in the production process. Different to the core model but customary in international trade theory, it is assumed that labour is mobile between sectors of a region but not between regions. The rest of the model is similar to the core model.

As in the core model, the income of consumers comes from two sources, namely income from work in the food sector and income from work in the manufacturing sector. Again, food is used as numéraire and is freely tradable between locations. Food production depends on the amount of available workers in the agricultural sector, i.e. $F = F(L_F) = F(1-\lambda) = 1-\lambda$ in the case of constant returns to scale. In this case, $W = 1$ and nominal wages will be equal across both, sectors and regions in the long-run.

In the equilibrium, the consumer income is a compound expression from income in the manufacturing and the food sector and will thus amount to

$$\begin{aligned} Y_1 &= W_1\lambda_1 + F\,(1-\lambda_1) \\ Y_2 &= W_2\lambda_2 + F\,(1-\lambda_2) \end{aligned} \tag{6}$$

in region 1 and region 2, respectively. As labour mobility is only possible within a region, i.e. between sectors, nominal wages must be identical if both sectors produce positive amounts. In the case of constant returns to scale and provided that $\delta < 1$, the nominal wage rate is $W = 1$.

As in the core model, transport of food between locations is free but transport of manufacturing varieties is costly with iceberg transport costs $T > 1$. Total demand for a variety is the sum of demand in both regions and equals to

$$\begin{aligned} x_1 &= E_1\, p_1^{-\varepsilon}\, I_1^{\varepsilon-1} + E_2\, p_1^{-\varepsilon}\, T^{-\varepsilon}\, I_2^{\varepsilon-1} \\ x_2 &= E_2\, p_2^{-\varepsilon}\, I_2^{\varepsilon-1} + E_1\, p_2^{-\varepsilon}\, T^{-\varepsilon}\, I_1^{\varepsilon-1} \end{aligned} \tag{7}$$

where E measures the total expenditures from consumers and firms using manufactures as intermediate inputs. Equating the break-even supply to total demand gives a total supply in both regions of

$$\alpha/(1-\beta) = E_1 p_1^{-\varepsilon} I_1^{\varepsilon-1} + E_2 p_1^{-\varepsilon} T^{1-\varepsilon} I_2^{\varepsilon-1}$$
$$\alpha/(1-\beta) = E_2 p_2^{-\varepsilon} I_2^{\varepsilon-1} + E_1 p_2^{-\varepsilon} T^{1-\varepsilon} I_1^{\varepsilon-1} \quad \textbf{(8)}$$

If the mark-up price is inserted, the wage rate in both regions can be calculated as

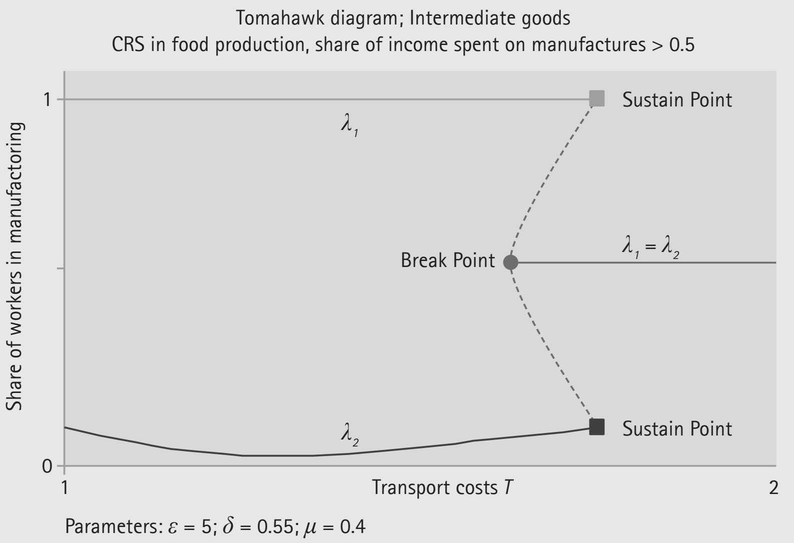
$$W_1 = [(1-\beta)/\alpha]^{1/\varepsilon(1-\mu)} I_1^{-\mu/(1-\mu)} (E_1 I_1^{\varepsilon-1} + E_2 T^{1-\varepsilon} I_2^{\varepsilon-1})^{1/\varepsilon(1-\mu)}$$
$$W_2 = [(1-\beta)/\alpha]^{1/\varepsilon(1-\mu)} I_2^{-\mu/(1-\mu)} (E_2 I_2^{\varepsilon-1} + E_1 T^{1-\varepsilon} I_1^{\varepsilon-1})^{1/\varepsilon(1-\mu)} \quad \textbf{(9)}$$

The wage rate in the model with intermediate inputs is quite similar to the wage rate already obtained for core model. One important feature of the model with intermediate inputs is that for $\mu = 1$, i.e. there are no intermediates in the production process, equations (21)–(23) simplify to the equilibrium of the core model. But, with intermediates in the production process there are also important differences compared to the core model. First, the total demand of a variety in equation (7) depends on total expenditures E instead of the consumer income Y representing that total demand comes not only from consumers but also from firms using manufactures as intermediate inputs. Second, given that $0 \leq \mu \leq 1$, the terms $I_1^{-\mu/(1-\mu)}$ and $I_2^{-\mu/(1-\mu)}$ and therefore the corresponding wage rates W_1 and W_2 get the higher, the lower the price index I. As I depends on the transport costs T, this means that the closer a firm is located to its suppliers of intermediates, the lower the costs and the higher the wage it can pay to its workers. This is a new feature of the model with intermediate inputs and marks another channel beneath choosing a location close to large markets (i.e. many consumers) whereby the location of a firm matters. This additional agglomeration force is called supplier access effect.

If the equilibrium equations (7)–(9) are used for simulations and the share of income of consumers spent on manufactures is sufficiently low ($\delta > 0.5$), the resulting tomahawk-diagram looks exactly like the one derived form the core model depicted in Figure 5. Nevertheless, the forces at work in the model with intermediate inputs are different. There are now potentially four forces at work, two of which are the same as in the core model and two of which are new. The two forces also at work in the core model are the extent of competition effect and the market size effect (often also called "home market effect"). The first one is a spreading force: as market size increases, the price index of manufactures decreases leading to a decrease in the demand for the varieties of each firm through more competition and therefore supports spreading. The second one is an agglomeration force: as market size increases, total income increases through either more workers or higher wages leading to an increase in the demand for the varieties of each firm and therefore supports agglomeration. The two forces that are new are the marginal productivity effect and backward linkages. Again, the first one is a spreading force, but it is only active in the case of diminishing returns to food: if workers move from the food to the manufacturing sector as firms start to agglomerate in a region, wages increase in the agglomeration region compared to the other region. These wage differentials in turn provide an incentive for firms to move to the other region. The backward linkage effect is an agglomeration force: being located close to many other firms – i.e. being located in a large market – has the advantage of being able to produce on lower costs as the intermediate goods needed in the production process are available without transport costs.

If the share of income of consumers spent on manufactures is large ($\delta > 0.5$), the equilibrium still looks similar to a tomahawk but it is apparent that is not exactly the same:

Figure 6: The intermediate goods model with constant returns to scale



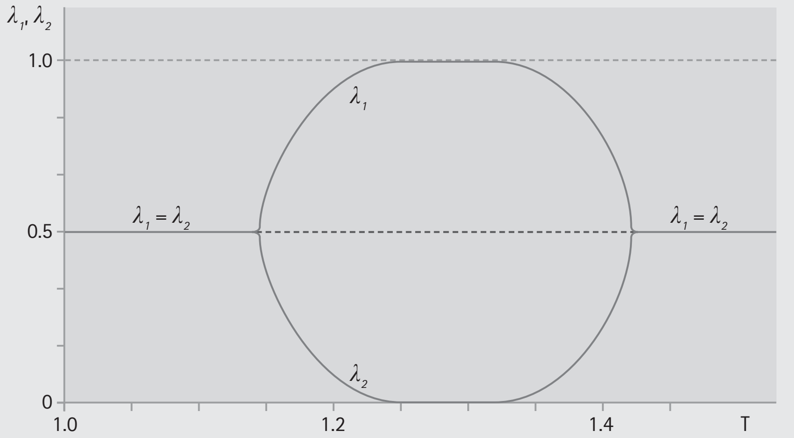
Source: Brakman/Garretsen/Marrewijk (2009) p. 186.

The difference to the core model results for high values of δ and gets visible in the degree of specialization in the peripheral region. Given that transport costs are high, the economy results in a spreading equilibrium. As transport costs start to decrease, this spreading equilibrium becomes unstable and deteriorates beyond the break point. The large region becomes completely specialized in manufacturing production while some manufacturing production still takes place in the peripheral region. In the peripheral region, nominal wages are equal to one in both sectors. In the large region, manufacturing wages are larger than or equal to one. If transport costs further decrease, the price index of manufactures in the large region falls. This decline in production costs drives up the demand for labour. But, as labour is fixed by assumption, market clearing in the large region must take place by higher wages. If the process of declining transport costs holds on, the advantage of being located in the large market (close to consumers and manufacturers of intermediate goods) becomes less important than wage differentials between the regions. Therefore, manufacturing production becomes more attractive in the peripheral region leading to an increase in labour demand and in manufacturing wages. This effect is described by the curvature of λ_2 in Figure 6 and continues until real wages in both regions are equal.

Krugman/Venables (1995) use the effects described above to explain the globalization process of the late nineteenth until the end of the twentieth century: they label the large region as North and the peripheral region as South, which one can easily image as OECD countries and developing countries. Then, at low levels of economic integration (given as high transport costs in the model), the economy will be in a spreading equilibrium and wages between regions will be equal. As the level of economic integration increases (transport costs start to decrease), however, one region (the North) becomes the core region in which manufacturing agglomerates and wages start to differ between North and South. This is what happened during a large part of the twentieth century. If a very high level of economic integration is reached, real wages start to converge again. This is what can be observed in the convergence literature since the 1980s.

If the assumption of constant returns to scale in food production is replaced by decreasing returns to scale, the intermediate goods model without interregional mobility reacts quite differently. Once, manufacturing firms start to agglomerate within a region, the additional labour demand from the manufacturing sector must pull workers out of the agricultural sector. For decreasing returns to scale in the agricultural sector, however, this leads to a higher productivity and thus higher wages in the agricultural sector. This in turn creates wage differentials between the two regions and makes the peripheral region more attractive. This spreading force is the already above mentioned marginal productivity effect. Given that the share of income of consumers spent on manufactures is low again ($\delta > 0.5$), the relationship between transport costs and the share of workers in the manufacturing sector does no more look like a tomahawk and might look like Figure 7:

Figure 7: The intermediate goods model with decreasing returns to scale



Source: Brakman/Garretsen/Marrewijk (2009) p. 191

The so called "bell-shaped curve" shows that the marginal productivity effect leads to stable spreading equilibria for low transport costs as lower wages in the peripheral region outweigh the advantage of intermediate linkages, i.e. being located close to consumers and producers of intermediates. As in the models discussed before, these spreading equilibria are unstable for medium transport costs and again stable for high transport costs. Thus, in the intermediate goods model without labour mobility and decreasing returns in food production, agglomeration only occurs for medium transport costs. This model has become popular among researchers and politicians as the catastrophic prophecy of full agglomeration in only one region does no more occur. As the spreading forces dominate the agglomeration forces for low transport costs, this is good news for peripheral regions as they now benefit from ever-increasing economic integration.

There are also other extensions of the core model that do not end up in a tomahawk diagram. The only thing, one has to ensure is that the spreading force does no weaken when T falls. The intermediate goods model ensures this by replacing interregional labour mobility by intersectoral labour mobility with a positive wage elasticity. Another example is the model by Helpman (1998) who replaces the agricultural sector by a housing sector. In his model, housing acts as a non-tradable consumption good and its supply is fixed by assumption. As workers start to agglomerate in a region, housing prices increase and act as a spreading force that does not get weaker with decreasing transport costs. Despite his approach allows for interregional labour mobility, the model finally ends up in a bell-shaped curve.

2.1.3 Economic geography and unemployment (disparities)

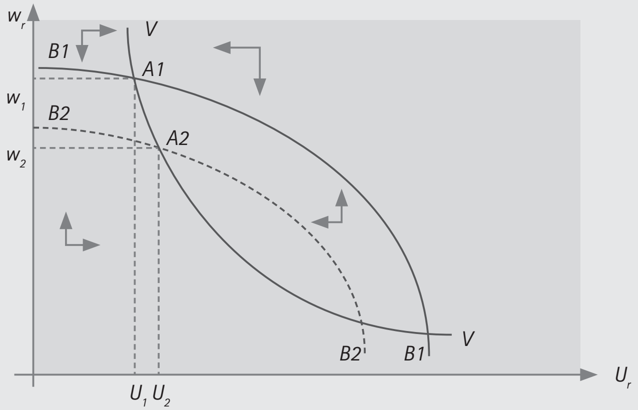
All those recent developments assume full employment and thus have nothing to say about unemployment disparities. Until now, only few attempts have been made to incorporate unemployment into geographical economics models. In this subsection we will focus on three different approaches to incorporate unemployment into the framework of economic geography.

Peeters/Garretsen (2000) use a standard geographical economics model with different types of workers (low and high skilled) and introduce wage rigidities that may lead to unemployment. Their aim is to explain the impact of globalisation (i.e. decreasing transport costs) on wages of low-skilled workers and unemployment, both variables that are typically negatively affected (i.e. wages of low-skilled decrease and unemployment increases) in the context of a Heckscher-Ohlin model frame. In their simulation studies, Peeters/Garretsen (2000) show that the influence of increasing integration on the unemployment rate depends crucially on the level and type of integration costs, the flexibility of wages and the distribution of low and high skilled labour. Starting from a certain level of economic integration (measured in terms of transportation costs), unemployment typically rises in the first stages of the globalization process. If, however economic integration further continues (transportation costs further decrease), both, increasing as well as decreasing spatial differences in regional unemployment are possible equilibria.

Epifani/Gancia (2005) combine a geographical economics model in the spirit of Krugman (1991a) and Helpman (1998) with an equilibrium unemployment model exhibiting search frictions following the idea of Pissarides (1990). In their model, transport costs generate agglomeration economies and trigger migration of the mobile workforce to the core region where frictions in the job matching process generate equilibrium unemployment. Epifani/Gancia (2005) find that in the short-run, migration towards the core region leads to an increase of the unemployment rate in the core and a decrease in the unemployment rate of the peripheral region and thus lowers regional unemployment disparities. This result is due to the direct effect of migration on labour supply where immigrants raise and emigrants lower the pool of job-seekers. The presence of search frictions in the matching process impedes the immediate integration in the labour market of the host region and thus the unemployment rate is positively related to immigration – at least in the short-run. In the long-run instead (if immigrants are absorbed in the host labour market of the core region), migration strengthens regional unemployment disparities. The adjustment process behind this result is that agglomeration economies increase profits in the core and induce the opening of new vacancies thereby lowering unemployment. The opposite happens in the peripheral region, where a fall in profits deteriorates the labour market conditions and produces unemployment. This process finally translates into a pattern of high-wage-low-unemployment regions in the core and low-wage-high-unemployment regions in the periphery. A congestion effect in the model serves as centrifugal force and prevents the peripheral region of complete deindustrialisation.

Another approach to link the findings of geographical economics models and unemployment is the approach of Suedekum (2005). In his paper, Suedekum (2005) incorporates the core properties of a geographical economics model into the empirically derived negative relationship between wages and unemployment first postulated by Blanchflower/Oswald (1990), known as wage curve. Suedekum founds his approach with a stylized fact based on the empirical pattern of unemployment and wages in European NUTS2-regions. He argues that first, unemployment is lower in the core regions of Europe which gives rise to support the arguments of the geographical economics models and second, regions with high unemployment show low wage rates and vice versa which shows the typical negative relationship postulated in the wage curve. Traditional wage curve models assume perfect competition on product markets and a production function that exhibits constant returns to scale. In his approach, Suedekum uses a production function with increasing returns to scale as commonly used in economic geography or the new trade theory. Furthermore, firms produce intermediate and consumer products for which iceberg transportation costs have to be paid if they are traded across regions. In the short-run equilibrium of the model (without labour mobility), both, the product market and the labour market equilibrium condition are functions of the real wage level that endogenously depends on the regional unemployment rate. Both conditions are depicted in Figure 8 and constitute the short-run equilibrium:

Figure 8: The wage curve model with increasing returns to scale



Source: Suedekum (2005) p. 173.

The product market equilibrium relations for region 1 and region 2 are represented by the curves B_1B_2 and B_1B_2 respectively. In contrast to standard wage curve models, they are concave and downward sloping in the presence of increasing returns to scale and iceberg transportation costs. The position of the product market equilibrium in each region depends positively on the labour force in the region as backward linkages become active: the larger the labour force, the more intermediates can be produced locally and therefore the larger are the savings of transportation costs and the higher the wage rate that must be paid if the zero profit condition holds. As Suedekum (2005) does not assume institutional differences between the two sectors, both regions face the same wage curve *VV*. The vertical and horizontal phased arrows show the adjustment forces in the disequilibrium case in one of both markets. As those forces always show towards the product and the labour market curves, there is only one possible equilibrium for each region. In Figure 8, the equilibrium in the larger region 1 results in A_1 and shows both, a higher wage rate as well as a lower unemployment rate as region 2 in its equilibrium A_1. This outcome explains the empirically found core-periphery pattern of wages and unemployment rates for the NUTS2 level mentioned above. At first sight, the outcome is qualitatively the same as in the usual wage curve models. The difference lies in the underlying forces that establish the wage curve: in standard wage curve models the negative relationship between wages and unemployment is caused by exogenous differences in productivity. In the model of Suedekum (2005), the relationship emerges solely through the better exploitation of endogenous market size effects (economies of scale).

In the long-run, agents are mobile and migration will set in if wage differentials between regions arise (in our example workers stream from region 2 to region 1). But, with localized increasing returns in production, migration is not an equilibrating force as with a neoclassical production technology. Quite the contrary is the case and migration rather perpetuates regional differences in wages and unemployment. The model of Suedekum (2005) lacks of a centrifugal force and the economy would therefore collapse into a point, i.e. full agglomeration would take place in either of the two regions (region 1 in Figure 8). As complete deindustrialisation of a region is not realistic, Suedekum (2005) therefore offers some possible mechanisms that lead to less than full agglomeration and ensure a long-run stability of the wage curve. In the case of homogenous workers, individual's disutility of congestion, their intrinsic attachment to the place of birth (home bias), differences in housing costs or intra-regional commuting costs would be possible centrifugal forces that impede complete migration into the larger region. If one instead assumes the rather more realistic fact of heterogeneous workers, where only the high skilled are mobile, migration costs itself may act as centrifugal force. As high skilled workers have a greater search efficiency and a wage premium compared to low skilled workers, the gain of migration rises with the personal skill level. If the costs of migration are considered as approximately equal for all kinds of workers, one can straightforwardly see that selective out-migration of high skilled workers will reinforce rather than equilibrate the spatial disparities. The effect of selective out migration will be the stronger the lower the migration costs are.

All models outlined in this subsection are interesting innovations of 'traditional' geographical economics models as they focus on an important economical fact that must not be neglected in the context of regional development, i.e. unemployment. Their conclusions are by no means uniform as they employ different approaches to combine accepted theoretical or empirical research with geographical economics models. Some commonalities may however be derived: in the short-run, unemployment in the core region seems to rise as economic integration increases. This seems to occur through the direct effect of immigration on the labour force where immigrants initially raise the pool of job-seekers and some frictions on the labour market avoid instant integration. In the long-run, however, unemployment in the core region seems to decrease with increasing economic integration and disparities between core and periphery seem to widen rather than to narrow as predicted in the neoclassical literature. In the models above, these results were derived either by simulations or by theoretical constructions. Until now, they all fail of an empirical test of these implications. As in most geographical economics models, the reason for this lack is that those implications are quite hard to test empirically. The differentiation between short-run and long-run effects is hard to determine in panel data with small time dimension. Furthermore, in the case of e.g. the wage curve, the outcome in the combined model can not be distinguished from the initial empirical approach of Blanchflower/Oswald (1990). Moreover, a core-periphery pattern of regional unemployment rates as found for the European NUTS2-level does not emerge in the case of west German districts. Therefore, we use another approach to answer the questions outlined in section 1, which is described in the following section.

2.2 An alternative labour market model of regional adjustment

A very popular approach in this field is the model proposed by Blanchard/Katz (1992). They present a framework of the regional economy which is – according to Elhorst (2003) – the most extensive regional model available. As Blanchard/Katz (1992) additionally propose the estimation of the model via a 3-equation VAR, their approach found a broad acceptance in the regional science literature. Until the publication in 1992, many researchers applied their approach for one or more countries to estimate regional adjustment processes after a labour demand shock. In many studies, the model and the estimation approach was taken over unchanged, in other studies, additional equations were added or different estimation techniques were used, but in total the approach was only slightly modified. Thus, the estimates across different countries in different papers are based on the same theoretical basis and substantially use similar empirical approaches. Additionally, all papers calculate impulse response functions for the respective estimates. These facts offer an ideal basis to compare the results of the articles related to the paper of Blanchard/Katz (1992) in a survey article.

The remainder of this section is as follows. First, section 2.2.1 renders the theoretical basis of the Blanchard/Katz-approach for a better understanding of the latter estimation results. Next, section 2.2.2 reviews the articles with respect to their main technical features. The results of all reviewed papers are analysed and discussed in section 2.2.3. Section 2.3 compares the findings and draws conclusions concerning the regional development in the countries under consideration.

2.2.1 Theoretical framework

In their regional model, Blanchard/Katz (1992) follow two basic ideas. Each region produces a specific bundle of goods and workers as well as firms are mobile across the country. The central question to be answered by the model is: What happens on the labour market if a region exhibits a shock in the demand of its products? Thus the model gives an answer to the very plausible case that a region is specialised in the production of certain goods and that the exogenous demand for these goods changes for some reason.

Formally, the theoretical model consists of the following 4 equations:

$$w_{it} = -d\,(n^*_{it} - u_{it}) + z_{it} \tag{10}$$

$$cw_{it} = -u_{it} \tag{11}$$

$$z_{it+1} - z_{it} = -aw_{it} + x_{di} + \varepsilon^{d}_{it+1} \tag{12}$$

$$n^*_{it+1} - n^*_{it} = bw_{it} - gu_{it} + x_{si} + \varepsilon^{s}_{it+1} \tag{13}$$

All variables are measured relative to the national mean. Equation (10) represents labour demand. The variable z_{it} marks the position of the labour demand curve. n^*_{it} stands for the logarithm of the labour force and u_{it} for the unemployment rate in region i at time t so that $n^*_{it} - u_{it}$ approximately represents the logarithm of employment. Thus, the labour demand equation (10) represents a negative relationship between the logarithm of the regional relative wage w_{it} and regional relative employment reflecting the downward sloping demand for each product.

Equation (11) states in the simplest way, that regional relative wages w_{it} are negatively related to the level of unemployment rate u_{it}. This relationship is commonly known as wage curve and was first introduced by Blancflower/Oswald (1990). It was proved to be valid in a large number of empirical studies for different countries, see e.g. Sanz-de-Galdeano/Turunen (2006) for the EU member countries, Iara/Traistaru (2004) for EU accession countries or Baltagi/Blien/Wolf (2009) for Western Germany.

Movements of the labour demand curve of each region are captured in equation (12). x_{di} is a drift term of labour demand and captures drifts in the demand of individual products as well as regional amenities such as natural resources or local taxes. ε^{d}_{it+1} is white noise and represents an innovation in labour demand. Thus, labour demand follows a random walk with drift. The parameter a is positive and states that Δz_{it+1} is negatively affected by regional relative wages w_{it}, i.e. lower wages make regions more attractive to firms. Thus, equation (12) states that job creation comes through lower wages.

Movements in the labour force Δn^{*}_{it+1} are expressed in equation (13). As in the labour demand equation, the labour supply is modelled as random walk with drift: ε^{s}_{it+1} is a white noise disturbance and the drift term x_{si}, if positive, captures regional amenities in labour supply such as a good climate or a pleasant landscape. Beyond these factors, fluctuations in labour supply are positively affected by wages w_{it} and negatively by the unemployment rate u_{it}. This specification characterizes that the labour force rises with higher wages and lower unemployment. Two major sources for changes in the labour force are net migration and changes in the participation rate. This means that the relative regional wage level and the unemployment rate determine the individual decision to enter the labour market in a specific region by moving into the respective region or by taking up work.

The solution given by the model holds for positive as well as for negative shocks, but the focus here is on a positive shock.[4] The story told by the model is that an increase in product demand directly translates into an increasing demand for labour as well as higher wages. Higher wages lead to net-out-migration of firms. Increasing labour demand and higher wages lead to a rise in employment. The adjustment of the employment level to increasing labour demand and higher wages (the additional workers needed) can work through different channels:

4 Pekkala/Kangasharju (2002) tested the hypothesis that positive and negative labour demand shocks display different adjustment paths. Their results show that region-specific shocks in Finland do only show little asymmetries.

additional workers may be required out of the pool of unemployed persons, people who do not participate in the labour market at present or from net-in-migration. Therefore, when a positive regional shock hits a region, the unemployment rate is expected to fall, while the participation rate and immigration should rise. How strong the employment level is finally affected by this demand shock, depends on the strength and speed of these adjustment mechanisms. The weaker wages respond to the shock, the more important is the adjustment of the employment level and therefore the larger is the permanent effect on employment. As the focus is on the physical adjustment processes on the labour market (the channels through which additional workers are hired), the response of wages is not further discussed in the following.

2.2.2 Reviewed papers – A technical discussion

The model of Blanchard/Katz (1992) has been widely used in the international research literature. Thus, a large body of literature that is based upon the same theoretical and empirical model has accrued in the last years. The question that arises is if systematic commonalities or differences can be found in the single papers. For this reason, a number of papers based on the model of Blanchard/Katz (1992) are reviewed in this section. They stem from different parts of the world and present results found for the US, European countries, Australia and New Zealand. For single countries within Europe we present results for the UK, Finland, Sweden, Belgium, the Netherlands, Germany, Italy and Spain. Additionally, estimation results for the (former) candidate countries of the EU are presented. Table 1 describes the articles reviewed in this section with respect to the empirical model, the estimation technique, the kind of obtaining regional variables, the lag-structure and the data frequency used in the empirical part.

From a geographic perspective, the 13 reviewed studies cover the US, EU member and candidate countries and the Australasian countries Australia and New Zealand. Thus, this survey covers mainly high developed countries. As the empirical part of the paper deals with unemployment differentials and adjustment dynamics in West Germany, especially the high number of studies for EU member and candidate countries should provide valuable insights about commonalities and differences in the European labour markets.

11 out of 13 articles use the basic empirical model introduced by Blanchard/Katz (1992), i.e. they estimate a trivariate VAR-model with the employment growth rate, the (un)employment rate and the participation rate as endogenous variables. Only Frederiksson (1999) and Petteri (2003) estimate extended versions. Frederiksson (1999) estimates a 5-equation VAR in the growth rate of regular employment,

the regular employment rate, the employment rate, wages and the labor force participation rate. Petteri (2003) also estimates a 5-eqation VAR. He additionally employs the net migration rate and the taxable income per capita to the basic system.

Table 1: Reviewed articles

Author (year)	Country	Model	Method	Variables	Lags	Data
Blanchard/Katz (1992)	US	Basic	Pooled OLS	Relative	2	Yearly
Decressin/Fatás (1995)	US, EU, UK, Italy, Germany	Basic	Pooled OLS	β-relative	2	Yearly
L'Angevin (2007)	US, EU	Basic	Pooled OLS	Relative	4	Yearly
Gács/Huber (2004)	EU candidate countries	Basic	Equation by Equation GMM	β-relative	1	Yearly
Frederiksson (1999)	Sweden	Extended	Mean Group Estimation	Relative	2	Yearly
Petteri (2003)	Finland	Extended	Pooled OLS	Relative	2	Yearly
Pekkala/ Kangasharju (2002)	Finland	Basic	Pooled OLS	β-relative	2	Yearly
Boersma/Dijk (2002)	Netherlands	Basic	Pooled OLS	β-relative	1	Quarterly
Estevao (2003)	Belgium	Basic	Pooled OLS	Relative	2	Yearly
Jimeno/Bentolila (1998)	Spain	Basic	Pooled OLS	Relative	2	Yearly
Mauro/ Spilimbergo (1999)	Spain	Basic	Pooled OLS	Relative	2	Yearly
McCaw/ McDermott (2000)	Australia, New Zealand	Basic	Pooled OLS	Relative	2	Quarterly
Debelle/Vickery (2002)	Australia	Basic	Pooled OLS	Relative	6	Quarterly

With respect to the estimation method, 11 from 13 articles use pooled OLS although the estimation of a dynamic panel specification as proposed in the paper of Blanchard/Katz (1992) renders the standard Least Squares Dummy Variable (LSDV) estimator biased since the error terms are correlated with the right-hand side variables. Only Gács/Huber (2004) and Frederiksson (1999) use different techniques. The former performs single equation estimation using the GMM estimator proposed by Arellano/Bond (1991) to yield consistent coefficients for the system given that the error terms of the equations are not autocorrelated and the variables included in the VAR are not integrated. Frederiksson (1999) employs the mean-group estimator developed by Pesaran/Smith/Im (1995), i.e. the mean of the estimates obtained from separate regressions for each group. This approach yields consistent estimates of the average effects as the number of time periods increases to infinity. Nevertheless, many studies report that alternative estimation techniques have been tested to check for the robustness of the estimates. Gács/Huber (2004) point out that the qualitative results do not alter if their equation-by-equation GMM approach is estimated by pooled OLS. Boersma/Dijk (2002) additionally tested a SURE-model which is able to account for correlations between the error terms of the single equations. They report that the coefficients are almost similar to their pooled OLS estimation. Debelle/Vickery (2002) tested the asymptotically efficient Feasible Generalized Least Squares (FGLS) approach versus pooled OLS and report that the gains in using FGLS are only small. Therefore, we conclude that different estimation techniques do not change the results of the different studies significantly.

Another distinctive feature of the reviewed articles is the way to construct region-specific variables. The two possibilities used by the authors are to construct region-specific variables as relative or as β-relative log-differences. The former is simply calculated as difference between the log of the regional variable minus the log of its national counterpart. The construction of β-relative variables instead considers that regions might react differently to a national shock and are therefore constructed as difference between the log of the regional variable minus β times the log of its national counterpart, where β is the estimated cyclical sensitivity of the respective variable to the national counterpart. The distinction becomes the more important, the more inhomogeneous the regions react to the national development. As regions are a part of the national total, this is more likely if a set of small regions is used. Large regions instead should be closely related to the national trend and β should be close to unity. Eight of the reviewed papers prefer relative differences and the other five use β-relative log-differences. In the articles, the decision if β-relative variables are constructed is mainly conditional upon the estimated β-coefficients of the univariate sensitivity regression according to Thirlwall (1966) and Brechling (1967).

The last two characteristic features denoted in Table 1 are the number of lags allowed in the estimated VAR and the data frequency. Most studies use yearly data and adopt a common lag-length of 2 periods as proposed in the seminal paper of Blanchard/Katz (1992). Gács/Huber (2002) instead preferred to use only 1 lag after testing lag-lengths of 1 to 3 years. According to their estimates, 1 lag performed best in different tests but the results of the estimates are similar to those obtained from an alternative 2- or 3-lag VAR-model. Boersma/Dijk (2002) also used only one lag and McCaw/McDermott (2000) two lags, although they estimated the trivariate system of equations on quarterly data. L´Angevin (2007) instead uses 4 lags and Debelle/Vickery (2002) 6 lags for their estimates. As Debelle/Vickery (2002) use quaterly data, the lag-length of 6 quarters seems adequate as this specification captures a time span of 1.5 years. Thus, with the exception of Boersma/Dijk (2002), McCaw/McDermott (2000) and L`Angevin (2007) all papers use lags reaching 1–2 years in the past.

To sum up, the 13 articles in Table 1 encompass a variety of information. Nevertheless, most studies simply adopted the empirical approach of Blanchard/Katz (1992) with respect to the main characteristic features. Furthermore, many authors tested alternative estimation approaches and often came to the conclusion that the results remain nearly unchanged. Therefore, the reviewed papers should be very well comparable and further discussion about different estimation techniques and model specifications can be reduced to a minimum. The fact that studies for the same country still differ in two important features – the observation period and/or the regional level of disaggregation – offers two further dimensions that one has to bear in mind if the results are compared. Therefore we will proceed in comparing blocks of regions in the following. These blocks are analyzed in section 2.2.3 and will review and appraise results first for the US, second for Europe and its candidate counties, third for single European member countries and fourth for Australasia.

2.2.3 Reviewed papers – Empirical results

In Table 2 the short-run-effects of a shock in employment and the duration until unemployment and participation rates return to their initial value (in years) have been summarized for the reviewed papers. The column "Adjustment" contains the share of adjustment that is captured by the unemployment rate u_i, the participation rate p_i, and migration m_i in the year of the shock. "Duration" is the number of years until the unemployment/participation rate return to their initial level for the first time. If the shock has settled in both variables, the additional workers that are needed to reach the new employment level come completely through migration.

Table 2: Main results of reviewed articles

Study		Adjustment			Duration	
Country	Author, year, region, time	u_i	p_i	m_i	u_i	p_i
US	Blanchard/Katz (1992), 51 regions, 1978–90	0.32	0.17	0.51	5	6
US	Decressin/Fatás (1995), 51 regions, 1976–90	0.18	0.30	0.52	4	6
US	L'Angevin (2007), 51 regions, 1973–05	0.22	0.34	0.44	6	13
US	L'Angevin (2007), 51 regions, 1990–05*	0.20	0.35	0.45	5	9
EU	Decressin/Fatás (1995), 51 regions, 1975–87	0.22	0.74	0.04	4	3
EU	L'Angevin (2007), 12 countries, 1973–05	0.33	0.44	0.23	> 15	> 15
EU	L'Angevin (2007), 12 countries, 1990–05*	0.30	0.45	0.25	13	> 15
EU	Gács/Huber (2004), 68 regions, 1992–98	0.35	0.68	–0.03	1	2
EU candidates	Gács/Huber (2004), 212 regions, 1992–98	0.16	0.71	0.12	2	4
UK	Decressin/Fatás (1995), 11 regions, 1975–87	0.15	1.00	–0.15	6	8
Germany (W)	Decressin/Fatás (1995), 7 regions, 1975–87	0.11	0.75	0.14	1	2
Italy	Decressin/Fatás (1995), 11 regions, 1975–87	0.28	0.67	0.05	2	> 15
Sweden	Frederiksson (1999), 24 regions, 1966–93	0.08	0.26	0.66	2	2
Finland	Petteri (2003), 11 regions, 1976–96	0.33	0.61	0.06	1	12
Finland	Pekkala/Kangasharju (2002), 11 regions, 1976–00	0.27	0.65	0.08	6	7
Netherlands	Boersma/Dijk (2002), 18 regions, 1993–99	0.14	0.74	0.12	1	2
Belgium	Estevao (2003), 10 regions, 1983–00*	0.18	0.57	0.25	> 15	3
Spain	Jimeno/Bentolila (1998), 17 regions, 1976–94	0.36	0.23	0.41	> 15	> 15
Spain	Mauro/Spilimbergo (1999), 50 regions, 1976–94	0.31	0.65	0.04	> 15	10
Australasia	McCaw/McDermott (2000), 9 regions, 1990–98*	0.35	0.55	0.10	> 15	> 15
New Zealand	McCaw/McDermott (2000), 8 regions, 1991–99*	0.77	0.31	–0.08	> 15	> 15
Australia	Debelle/Vickery (2002), 8 regions, 1979–97	0.20	0.40	0.40	5	2

2.2.3.1 Adjustment in the US

Several studies analyze the US labour market dynamics. All papers under review, i.e. Blanchard/Katz (1992), Decressin/Fatás (1995) and most recently L´Angevin (2007), estimated a trivariate system for the 51 US-states but used different observation periods. Blanchard/Katz (1992) used a data set from 1978–1990, Decressin/Fatás (1995) from 1976–1990 and L´Angevin (2007) for the periods 1973–2005 and 1990–2005. In all studies the results are quite similar: migration seems to play the dominant role in the US labour market adjustment process. With approximately 50 percent, it captures nearly half of the shock already during the same period. The unemployment and the participation rate instead capture roughly 20–35 percent. In Blanchard/Katz (1992) the unemployment rate still captures 32 percent whereas participation covers only 17 percent. This is nearly reverse in the other three estimates: Decressin/Fatás (1995) as well as L´Angevin (2007) report that the unemployment rate captures only about 20 percent and the participation rate about 30–35 percent. With respect to the duration of the adjustment mechanism, all estimates for the US report that an employment shock has a shorter-lived effect of about 4–6 years on the unemployment rate. The participation rate needs approximately 6–10 years to return to its initial value.

2.2.3.2 Adjustment in Europe and its candidate countries

As for the US also for Europe several studies exist. Decressin/Fatás (1995) used a data set of 51 countries and regions with approximately the same size in the period 1975–1986. For France, Germany, Italy, Spain and the UK they had regional data whereas Belgium, Denmark, Greece, Ireland, the Netherlands and Portugal were treated as single regions. L´Angevin (2007) estimated the trivariate system with national data for 12 countries (Austria, Belgium, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, Netherlands, Portugal, Spain). As for the US, they estimated the empirical model for the relatively long period 1973–2005 as well as for the more recent period from 1990–2005. Gács/Huber (2004) employed regional data from EU member countries (Germany, Italy, Netherlands, Portugal, Spain) as well as for EU candidate countries (Czech Republic, Poland, Hungary, Bulgaria, Romania) in the time span 1992–1998. Data for candidate countries usually were on a much smaller regional level than those for EU member countries.

In all estimates with European data, the participation rate was the major equilibrating mechanism. According to the different estimates, its share of adjustment after an employment shock amounts to about 44–74 percent in the period of the shock. The unemployment rate is the second important adjustment mechanism and covers approximately 22–35 percent of the employment shock in the period of the shock in EU member countries, but only 16 percent in EU candidate countries. Migration instead accounts for the lowest share in all estimates and seems to play a minor role in the European adjustment to employment shocks. Its share of adjustment in the period of the shock ranges between –3 and 25 percent. With regard to the regional level it is apparent that smaller regions from the EC candidate countries in the estimates of Gács/Huber (2004) as well as the estimates of L´Angevin (2007) with country data show higher migration shares than those of "typical" regions employed by Decressin/Fatás (1995) or Gács/Huber (2004) in the period of the shock. This is possible for smaller regions as migration across boarders occurs more often, see Gács/Huber (2004). For country data used by L´Angevin (2007) one would instead suppose that the share of an employment shock that is adjusted by migration tends towards zero in the culturally very heterogeneous European countries. However, this is not the case and migration amounts to 25 percent in the period of the shock for the most recent estimation period 1990–2005. One reason might be that L´Angevin (2007) – in contrast to Decressin/Fatás (1995) and Gács/Huber (2004) – used relative instead of *ß*-relative variables. These differences continue in the estimated duration of adjustment. Decressin/Fatás (1995) and Gács/Huber (2004) report adjustment periods of 1–4 years for the unemployment rate and 2–4 years for the participation rate. L´Angevin (2007) instead reports adjustment durations of more than 13 years for the unemployment rate and more than 15 years for the participation rate.

Following the regional estimates of Decressin/Fatás (1995) and Gács/Huber (2004), European labour markets react differently than the US labour market. Adjustment to a region-specific labour demand shock in Europe is mainly via the participation rate, partly via the unemployment rate but hardly via migration. The US adjustment after an adverse shock to labour demand is instead mainly via interregional migration and only partly via the unemployment and the participation rate. The time span until the adjustment of the unemployment and the participation rate has completely settled is however faster in Europe than in the US – i.e. the unemployment and the participation rate return faster towards their initial value in Europe than in the US.

2.2.3.3 Adjustment in single EU countries

Eight authors also report results for single EU countries. The reviewed papers cover results for 10 countries in northern, central and southern Europe and can therefore be viewed as a representative sample of EU countries. In particular, we present results for the UK (1), the northern European countries Sweden (1) and Finland (2), the central European countries Germany (1), the Netherlands (1) and Belgium (1) and the southern European countries Italy (1) and Spain (2). All studies use regional data. The number of regions varies between 7 in Germany to 50 in Spain. The half of these studies use data on NUTS1- or NUTS2-level, where most of the regional units have a population of more than one million inhabitants. In the northern European countries Finland and Sweden as well as for the Netherlands and in the study by Mauro/Spilimbergo (1999) for Spain, the region size is on a smaller regional level (NUTS3- or aggregated NUTS3-areas), where the regions have a population of lower than one million inhabitants. As the sparsely populated northern European countries Finland and Sweden as well as the 50 Spanish provinces used by Mauro/Spilimbergo (1999) are still relatively large areas, the regional units are of quite similar size for the larger European countries. Really smaller regional units are only used for the Netherlands and Belgium. With respect to the estimation period, all studies for larger EU counties have an overlap period of 11 years from 1976–1987. This is nearly the whole observation period used by Decressin/Fatás (1995). Despite the Swedish study by Fredericsson (1999) who uses a long observation period of nearly 3 decades from 1966–1993 – all other studies for lager countries use 7 to 13 additional years. Thus, most studies of larger European countries have an overlap of more than 50 percent of their time-series observations. The studies for the smaller EU countries the Netherlands and Belgium by Boersma/Dijk (2002) and Estevao (2003) respectively, use more recent data. The number of observation periods is instead similar to those of larger countries. Boersma/Dijk (2002) use 28 quarters and Estevao (2003) 18 years. Thus, the results of larger EU countries can well be compared as they generally use a larger regional level and have an overlap of more than 50 percent in the observation period. The studies for the Netherlands and Belgium use a smaller regional level, but have only a relatively short time-series overlap of 7 years which is less than 40 percent (in terms of years). As they additionally use different methods to construct region-specific variables, see Table 1, comparisons between the Netherlands and Belgium should be interpreted with caution.

Over all single-country results, the above finding that the participation rate is the main adjustment mechanism in European countries is confirmed. With the exception of Frederiksson (1999) for Sweden and Jimeno and Bentolila (1998) for Spain, the share of adjustment to an employment shock that is covered by changes in the participation rate varies between 61 and 100 percent. The adjustment share of the unemployment rate is of medium size and ranges between 11 and 36 percent and migration is only low in most estimates. Only Frederiksson (1999) and Jimeno and Bentolila (1998) for Sweden and Spain respectively report substantial migration already in the year of a labour demand shock.

The distinction between northern, central and southern European countries does not show many striking features: According to the estimates of Decressin/ Fatás (1995), the UK seems to adjust nearly fully via the participation rate. Furthermore, a negative employment shock even leads to immigration than to the expected emigration in the period of the shock. The neighbour countries Finland

and Sweden show marked differences with respect to the migration behaviour. According to the estimates of Frederiksson (1999), the Swedish adjustment to a negative labour demand shock works predominantly via migration, whereas the estimates of both, Petteri (2003) and Pekkala/Kangasharju (2002) show Finland as a typically European country. The central European countries Germany, the Netherlands and Belgium show very similar reactions to a labour demand shock. Especially Germany and the Netherlands nearly have the same values for the adjustment shares for unemployment, participation and migration during the year of the shock and similar durations afterwards although the estimates for the Netherlands are based on quarterly data for a more recent period as well as on a smaller regional level. Roughly spoken, the major adjustment mechanism is a change in the participation rate and the rest is adjusted approximately equally via the unemployment rate and migration. In the southern European countries Italy and Spain the adjustment to a negative labour demand shock is approximately by one third via the unemployment rate. The two estimates for Spain by Jimeno/Bentolila (1998) and Mauro/Spilimbergo (1999) show instead quite different values for the adjustment shares of the participation rate and migration although the sample period is the same. Although the first study is on a larger regional level, Jimeno/Bentolila (1998) report that 41 percent of a labour demand shock is adjusted via migration in the period of the shock and participation covers only 23 percent. Mauro/Spilimbergo (1999) instead report that only 4 percent of the adjustment are due to migration but 65 percent are due to changes in the participation rate. The Italian results found by Decressin/Fatás (1995) are instead very close to the results of Mauro/Spilimbergo (1999).

Thus, results for northern, central and southern European countries are quite homogenous with two exceptional cases for Sweden and Spain. If ever, one might suppose that southern European countries have a higher share in the adjustment mechanism via the unemployment rate compared to central and northern European countries. Additionally the speed of adjustment towards the steady state seems to be lower in southern European countries: in 2 out of 3 studies the duration until the unemployment/the participation rate are back towards their initial values is more than 15 years. In northern and central Europe however, this is the case in only one out of 7 studies (Belgium) for the unemployment rate and in no one for the participation rate.

2.2.3.4 Adjustment in Australasia

In our review, two papers report results for the Australasian countries Australia and New Zealand. The two studies differ only in the observation period and the lag length. Debelle/Vickery (2002) use a quite long period of 1979–1997 and employ 6 lags in their estimates with quarterly data for Australia. McCaw/McDermott (2000) also use quarterly data for 1990–1998 for Australasia and 1991–1999 for New Zealand and employ 2 lags. Thus, the estimates of McCaw/McDermott (2000) are nearly in the same time-span and have an overlap period in the recent decade of 7–8 years with the study of Debelle/Vickery (2002). As this is fewer than the half of their time-span of 19 years, the results of McCaw/McDermott (2000) are only of limited comparability to those of Debelle/Vickery (2002).

The results for Australasia are similar to those obtained for Europe. The participation rate is the major equilibrating mechanism and covers approximately 55 percent in the year of the labour demand shock. The adjustment share of unemployment amounts to 35 percent and migration has only a low share of 10 percent. But, different to the estimates for Europe, the adjustment mechanism is slower and lasts more than 15 years to return to the steady state. The separate estimates for Australia and New Zealand instead show that both countries have quite different reactions to labour demand shocks. The Australian labour market reacts mainly through the participation rate and migration during the year of the shock. Unemployment plays only a minor role. The estimated shares for the unemployment (20 %), the participation rate (40 %) and migration (40 %) are between the results found for Europe and the US. The duration until the labour market variables are back towards their steady state level amounts to 5 years for the unemployment and 2 years for the participation rate – also values that are commonly found in both, Europe as well as the US. In New Zealand, adjustment works mainly through changes in the unemployment rate. In the year of the shock, approximately 77 percent are covered by the unemployment and 31 percent by the participation rate. Instead of the expected emigration after a negative labour demand shock, a shock leads to an immigration of 8 percent. Additionally, labour market adjustment is very slow: the unemployment as well as the participation rate need more than 15 years to return to their initial values.

To sum up, labour market adjustment in Australasian countries Australia and New Zealand is quite different and should not be lumped together. The Australian labour market adjusts quite rapidly to labour demand shocks – mainly via the participation rate and migration. The estimated shares and durations range between the values found in Europe and the US. Labour market adjustment in New Zealand is instead quite slow and predominantly driven by changes in the unemployment rate.

2.3 Conclusions from existing empirical work

In section 2, a variety of papers covering the US, Europe and its candidate counties as well as Australasia were reviewed. Most of the reviewed studies simply adopted the empirical approach of Blanchard/Katz (1992) with respect to the main characteristic features. Furthermore, many authors tested alternative approaches and often came to the conclusion that the results remain nearly unchanged. Therefore, the reviewed papers are very well comparable with respect to the technical implementation. As studies for the same country still differ in the observation period and/or the regional level of disaggregation, the papers were compared in blocks of regions. The main results are the following:

The US adjustment after an adverse shock to labour demand is mainly driven by interregional migration and only partly via the unemployment and the participation rate. Adjustment to a region-specific labour demand shock in Europe is instead mainly via the participation rate, partly via the unemployment rate but hardly via migration. The time span until the adjustment of the unemployment and the participation rate has completely settled is however faster in Europe than in the US – i.e. the unemployment and the participation rate return faster towards their initial value in Europe than in the US.

Within Europe, results for northern, central and southern European countries are quite homogenous except two studies for Sweden and Spain. If ever, one might suppose that southern European countries have a higher share in the adjustment mechanism via the unemployment rate compared to central and northern European countries. Additionally the speed of adjustment of the unemployment/participation rate towards the steady state seems to be lower in southern European countries as a duration of more than 15 years can be found nearly always while this is only the case in one country (Belgium) in the northern and central European countries.

Labour market adjustment in Australasian countries Australia and New Zealand is quite different and should not be lumped together. The Australian labour market adjusts quite rapidly to labour demand shocks – mainly via the participation rate and migration. The estimated shares and durations range between the values found for Europe and the US. Labour market adjustment in New Zealand is instead quite slow and predominantly driven by changes in the unemployment rate.

In the following empirical part of the paper, the three key questions posed above are sequentially answered: section 3 generally deals with the question if the unemployment rates across districts and regions within Germany show convergence or if regional differences tend to increase. Therefore, time-series estimation techniques for univariate panel data are employed. In section 4, a VAR-model in the spirit of Blanchard/Katz (1992) that is additionally able to account for commuting as adjustment mechanism is estimated. In the final empirical section 5 a hybrid approach of equilibrium and hysteresis models – the chain reaction theory of unemployment – is introduced: the theory was proposed by Karanassou/Snower (2000) and is able to separate the effects of exogenous variables from lagged adjustment processes. The empirical estimation is implemented as 4-equation vector-autoregressive model (VAR). Finally, section 6 summarizes and evaluates the results found in sections 2–5 and offers some politic related recommendations.

3 Disparities, persistence and dynamics of regional unemployment rates in Germany – an univariate analysis

As outlined above, persistent high unemployment is one of the main problems faced by the German economy at present. Changes in the economic or political settings such as the oil price shocks at the beginning of the 1970s and 1980s or German reunification in 1989 led to a substantial rise in the national unemployment rate during the last decades. After each shock, the unemployment rate recovered slightly but did not return to its initial level. This observation suggests the existence of a slow-working adjustment to aggregate shocks. However, regions within the country are different in structure and should therefore react differently to common shocks such as a sharp rise in oil or steel prices. Furthermore, they may also react to specific shocks concerning certain regions or possibly one single region only, e.g. the establishment or closure of a major employer.

Decressin/Fatás (1995) find that aggregate shocks lead to persistent effects in European labour markets, whereas no such effects are found for the US. However, the regional unemployment rate is hardly affected after a region-specific shock in either Europe or the US. For Germany, research on adjustment is available for example in Decressin/Fatás (1995) and Möller (1995). Similar to their results for Europe, Decressin/Fatás (1995) find that a region-specific shock in Germany has settled completely after a few years. By contrast, Möller (1995) finds that after a shock the regional unemployment rate takes one to two decades to return to its initial value.

Since the datasets used by Decressin/Fatás (1995) and Möller (1995) reach only until the late 1980s/mid 1990s, their estimates do not capture major changes in the structural economic settings: a rapidly developing information technology sector and increasingly cheap transport (on the land as well as in the air, e.g. through low-budget airlines) have lowered transportation costs and increased the speed at which information, people and goods can be conveyed. These developments, together with the increasing openness of Eastern European and Asian countries, have led to an immense speed in the globalization of markets. It has become possible for firms to outsource large parts of their production to cheaper locations, first to Eastern Europe and later also to the Far East. The effect that these developments have had on the German labour market are hard to measure, but the labour market conditions in Germany changed substantially during the last decade. The number of regular jobs (jobs covered by social security) decreased steadily and other forms of employment (part-time jobs, low and middle income jobs not covered by social security) started to flourish (see e.g. Dietz/Walwei 2006). The implications of these developments for the adjustment of national and regional labour markets and especially the unemployment rate are not clear and must therefore be re-investigated for more recent years. As both Decressin/Fatás (1995) and Möller (1995) report only adjustment dynamics after a region-specific shock in western German regions (regional employment office areas[5]), this paper additionally provides results for regional adjustment dynamics after aggregate shocks in these regions.

Given persistent high unemployment at national level in 2004, unemployment rates vary substantially at district level (NUTS3) in Germany. While some regions in southern Germany show unemployment rates of less than 5 percent and are therefore close to full employment, other districts – mainly situated in eastern Germany – are in a deep crisis and exhibit rates of more than 25 percent at the same time. The estimates are therefore also carried out at district level. There are good reasons why smaller regional units should behave differently than larger regions. Districts, for example, can hardly be seen as closed labour markets. The migration and commuting activities between neighboring districts are more intense than in larger regional units, where much of this takes place within the region. Thus, the adjustment after a (region-specific) shock should be reflected far more in interregional migration and commuting and less in the unemployment and the labour force participation rates.

The aim of this paper is to study the dynamics of regional unemployment rates at different regional levels. The main questions are: Do unemployment rates converge towards the national unemployment rate or instead towards a stable pattern of unemployment disparities, i.e. a spatial equilibrium distribution? Are unemployment rates persistent at district level in Germany? How strong is this persistence? Has the speed of adjustment in the aftermath of aggregate/region-specific shocks changed over time? Are the adjustment mechanisms at district level different to those observed for larger regional units? If so, are they slower or faster, weaker or stronger?

This section provides detailed analyses for these questions. The main results show that the distribution of regional unemployment rates displays strong persistent behaviour. Both districts and larger regions in Germany converge towards their region-specific steady states and therefore towards a stable pattern of unemployment disparities rather than towards the national mean. The degree of persistence in the aftermath of aggregate shocks decreased markedly during the last decades. For more recent years (1989–2004) however, neither aggregate nor region-specific shocks lead to persistent behaviour. A comparison of the adjustment paths of different regional levels shows that districts react to shocks in a very

5 Some of the regional employment office areas are identical to Federal States, some of them are larger. A detailed description follows in Section 3.2.

similar way to larger regional units. Altogether, these results are a strong indication that the observed persistent distribution of regional unemployment rates can be interpreted as an equilibrium configuration.

Whenever possible, evidence from the US, Europe or Germany is given in order to compare our findings with the conclusions of other authors. When interpreting these comparisons it has to be borne in mind that

- the district level is a smaller regional level (NUTS3) than the usual disaggregation used for the US, Europe or other national studies (these are mainly the size of NUTS2 regions)
- districts within Germany all have the same institutional settings, so research at this level is therefore comparable with nationwide research but not for example with European research.

Estimates are thus carried out for larger regional units as well as for districts in order to be able to compare the results directly with other studies.

The remainder of the paper is as follows: section 3.1 gives a short summary of the relevant theoretical background. Section 3.2 briefly describes the dataset and the aims of the methods used in this paper. In section 3.3, different approaches to measuring the relative unemployment rate are discussed. Section 3.4 gives a detailed picture of the disparities and persistence of unemployment rates at district level in Germany. Section 3.5 analyses the dynamics of regional unemployment rates for districts and regions and section 3.6 concludes this section.

3.1 Theories of unemployment disparities

According to Frederiksson (1999) the comparatively stable pattern of regional unemployment disparities found in European countries may have different origins. First, these disparities constitute an equilibrium phenomenon. Second, both aggregate and region-specific shocks occur at such frequencies that disparities remain although regional adjustment mechanisms exist to equilibrate these disparities and third, different reactions to common and region-specific shocks in combination with slow-working adjustment mechanisms build and maintain regional disparities over long periods. Due to these explanations, two different points have to be investigated: first, the development of the distribution of unemployment rates across regions and second, the adjustment of regions to shocks.

The first point deals with the question of whether the unemployment disparities at district level in Germany constitute an equilibrium configuration or whether unemployment disparities become smaller or larger. Theoretical explanations are available for all three cases: in a typically neoclassical approach, production factors such as capital or labour are mobile across regions and should equilibrate regional disparities.[6] The argument of factor mobility is generally valid between regions of different countries, but it is even more striking if disparities emerge within countries. As all regions within a country act under the same institutional settings, the unemployment distribution should converge towards the national mean.

Regional models that lead to stable or increasing disparities of regional variables were developed after Romer (1986) and Lucas (1988) introduced the new growth theory. In these models, constant or even increasing returns to production factors lead to constant or increasing growth differentials and therefore to permanent or widening regional disparities. As models following the new growth theory assume full employment, they are only of limited relevance in explaining unemployment differentials.

A third type of model is able to account for convergence as well as divergence of regional disparities. Based on ideas that were already discussed in Marshall (1920) and Myrdal (1957), the seminal papers of Krugman (1991a) and Krugman/Venables (1995) initiated the new economic geography: economic activities tend to concentrate in large agglomerations because of agglomeration advantages (internal and external returns to scale) and a positive home market effect (location decisions are made close to the place of demand). In the presence of transportation costs, this constellation produces centralizing forces and therefore leads to divergence. Only if the degree of economic integration is low and transportation costs are therefore high, agglomeration advantages and the home market effect are overcompensated by locally producing and providing goods without transportation costs leading to a dispersion of economic activities and thus to convergence.

Interestingly, in the recent literature examples of divergent forces with respect to regional unemployment differentials can be found for neoclassical approaches as well as for models based on the new economic geography. Suedekum (2004) uses a neoclassical approach where skill-biased migration flows, i.e. a regional "brain drain", lead to an increasing divergence of regional unemployment. Epifani/Gancia (2005) on the other hand employ a new economic geography model to show that even in the presence of negligible migration costs, stable unemployment gaps between the core and the peripheral region result.

Following Frederiksson (1999) the other relevant question is whether shocks are only temporary or whether they lead to permanent effects in the unemployment rate. According to Elhorst (2003), the most extensive model to study regional adjustment is that developed by Blanchard/Katz (1992). In their model, a region responds to a labour demand shock through the adjustment of wages, the unemployment rate,

6 For a synopsis of the neoclassical model of regional growth, see e.g. McCombie (1988).

the participation rate and interregional migration. The strength and speed of these adjustment processes are determined by the elasticities of labour demand.

This section provides detailed analyses referring to the convergence/divergence of regions as well as to the adjustment processes after shocks, as the empirical part examines the development of the distribution of unemployment rates across regions and the adjustment of regions to shocks separately. Beforehand, the dataset and the empirical methods used in this section are briefly introduced.

3.2 Regional data and methodological issues

The dataset of unemployment series used in this paper is provided by the German Federal Employment Agency (Bundesagentur für Arbeit). All of the series are on an annual basis. As already mentioned above, section 3 pursues two aims: first, to be able to compare the development across different levels of aggregation and second, to make comparisons with estimates by other authors. Therefore, time series of different lengths for different regional levels are used. Due to the historical situation of Germany being divided until 1989, data for eastern and western Germany are not available to the same extent. At district level (439 districts), the western German unemployment rates for 1980 and from 1989–2004 and the eastern German rates from 1996–2004 are official figures from June of each year. The unemployment rates are calculated as the number of unemployed in relation to the dependent labour force.[7] Therefore, estimates and comparisons for unified Germany are only possible for the period 1996–2004. These data are used to describe the disparities and persistence of unemployment rates in section 3.4. For the estimation of unemployment dynamics in section 3.5, only western German unemployment rates are used because of their better time-series properties (longer series). For comparisons with results obtained by other authors, longer time series at a larger regional level are needed. Official figures from the Federal Employment Agency are available for western Germany only, to be more precise, for western German regional employment offices. Regional employment offices are closely related to the administrative level of Federal States. The regional employment office areas of Baden-Württemberg (BW), Bavaria (BV), Hesse (HE) and North Rhine-Westphalia (NRW) are identical to the corresponding Federal States. Each of the other three offices covers a larger and a smaller Federal State: Schleswig-Holstein/Hamburg (SHH), Rhineland-Palatinate/Saarland (RPS) and Lower Saxony/Bremen (LSB). For these seven units, which we refer to as "regions" in the following, the

7 The dependent labour force includes employees subject to social security, marginal part-time employees, civil servants, the unemployed and expatriates.

unemployment rates from 1966–2004 are used in section 3.5 to make comparisons with estimates by other authors. Because of a structural break in the data due to a change in the definition of the unemployment rate in 1989,[8] only complete periods before or after the structural break are used for the comparisons.

In the following three sections, different methodological approaches are applied to characterize the disparities, persistence and dynamics of unemployment rates across German districts and regions. Here, a short overview is given to describe the intention of the applied methods. Extended descriptions can be found in the relevant sections.

In section 3.3, the cyclical sensitivity model according to Thirlwall (1966) and Brechling (1967) is estimated to measure how strongly the regional unemployment rate parallels the national unemployment rate. The estimated coefficients are used to derive relative unemployment rates. As one aim of the paper is to distinguish between aggregate and region-specific developments affecting the distribution and the adjustment processes of regional unemployment rates, all of the estimates are carried out for the absolute measure, i.e. the official unemployment rate as well as the relative measure, i.e. the estimated region-specific unemployment rate in sections 3.4 and 3.5. Section 3.4 deals with the disparities and persistence of regional unemployment rates. As a basic principle and in contrast to section 3.5, the disparities and persistence are analysed for districts only, as cross-section methods are applied and there are only seven units for regions. In section 3.4.1, the disparities are illustrated simply and analysed using maps. Persistence is measured in section 3.4.2 by means of a regression of regional unemployment rates at different points in time. The smaller the changes in the unemployment rates of regional units at different points in time, the stronger the persistent behaviour, as unemployment rates do not tend to vary over time. The results in section 3.5 are presented for regions as well as for districts. Section 3.5.1 seeks to answer the question whether the distribution of regional unemployment rates tends to converge towards a stable pattern of unemployment disparities or towards the national mean. This is done by estimating panel unit root tests and an autoregressive fixed-effects model to see if the regional or even the national mean act as an attractor for regional unemployment rates. Finally, in section 3.5.2, impulse responses of unemployment rates to aggregate and region-specific shocks are calculated to illustrate and measure the strength and speed of the adjustment processes at work.

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8 Before 1989, the dependent labour force was (under)estimated from the German "microcensus". For the years 1989–2000, the dependent labour force includes employees subject to social security, civil servants, the unemployed, expatriates and estimates of marginal part-time employees from the microcensus. Since the year 2000, marginal part-time employees have been covered by social security and have therefore been included in the official figures for the dependent labour force. In contrast to 1989, the inclusion of official figures for marginal part-time employees in 2000 does not lead to a marked structural break.

3.3 A measure of relative unemployment

If the matter of interest is the evolution of regional unemployment, it is necessary to fade out the variation due to the national component in order to observe the evolution of pure regional factors affecting the regional unemployment rate. A common method is to use the difference or the quotient between the regional and the national rates. But, as argued in Martin (1997), the conclusions that can be drawn from an investigation of regional unemployment disparities may seriously depend on the choice of these measures. While differences remain stable if the regional and the national rates change in the same absolute amount, ratios will converge or diverge. If, however, the regional and the national rates change in the same proportionate amount, ratios remain stable, but differences widen or narrow. Thus, if the objective is to investigate the evolution of regional disparities in the absence of aggregate movements, the choice of the measure determines the underlying hypothesis. In fact, in using differences to address this question, one assumes constant differences, if ratios are used, one assumes constant ratios between the regional and the national unemployment rates. This is important, because it makes a considerable difference if the equilibrium outcome for a region is x percentage points above or below the national value or x times the national value.

In this section, the measure of relative unemployment is discussed as this is crucial for the construction of region-specific variables. Blanchard/Katz (1992) and Decressin/Fatás (1995) use region-specific variables in their analyses. However, they employ different measures. This section therefore investigates different approaches for obtaining region-specific variables – especially ways to deal with national information hidden in the data. An important issue in this context is how strongly regional unemployment rates are driven by the variation in the national unemployment rate. Here, this question is addressed according to the cyclical sensitivity model introduced by Thirlwall (1966) and Brechling (1967).

The central idea behind the cyclical sensitivity model is that the regions within a country are driven by national as well as regional factors. The extent to which national factors are of importance for the regional development can easily be measured using a region-specific time-series regression of the following type:

$$U_{it} = a_i + b_i U_t + e_{it} \qquad \textbf{(14)}$$

where U_{it} and U_t are the regional and the national unemployment rates, respectively. Thus the parameter b_i measures how the unemployment rate in region *i* is affected by variations in the national unemployment rate. There are numerous reasons why b_i should vary across regions. If, for example, a nationwide, Europe-wide or world-wide shock (such as rising oil or steel prices) affects regions differently because of differences in their sectoral structure, this might be reflected in different coefficients. Thus, the national unemployment rate captures factors which are common to all regions and the coefficient measures how a region parallels the nationwide development. One could also think about the inclusion of a time trend into the cyclical sensitivity model to capture the structural changes of regions. This inclusion would be adequate to improve the fit of the model as it would capture converging or diverging development paths between the regional and the national unemployment rate. But, as the research of convergence and divergence is the aim of this chapter, we consciously do not include a time trend to keep this information in the regional relative unemployment rates.

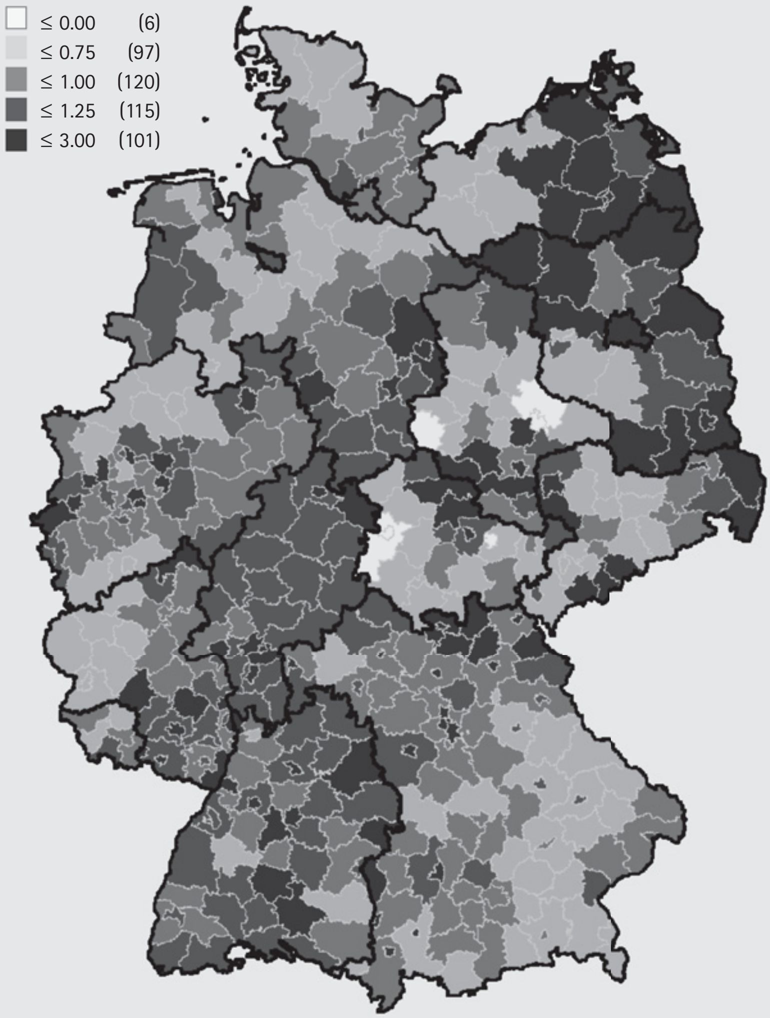
Equation (14) was run for each district separately. Thus, there are 16 observations for western German districts and 9 observations for eastern German districts. Because of the sharp differences between the unemployment rates of the eastern and the western parts of Germany, the cyclical sensitivity parameters are estimated for each district using the eastern/western German unemployment rate respectively. The spatial distribution of the cyclical sensitivity parameter of each district can be seen in Figure 9.

The map confirms the regional differences in the cyclical sensitivity. The range of the coefficients extends from –0.46 in Wernigerode (Saxonia-Anhalt, eastern Germany) to 2.59 in Uecker-Randow (Mecklenburg-Western Pomerania, eastern Germany) signifying that there are districts showing acyclical behaviour as well as districts with strong procyclical development.[9] In 223 districts the cyclical sensitivity is smaller than one, in about 40 percent of these cases (89) it is significantly lower. Of the districts with a sensitivity greater than one (216), 65 (about 30 %) show a significant procyclical development. Some districts in western Germany (e.g. in southern Bavaria, western Rhineland-Palatinate, northern North Rhine-Westphalia, Lower Saxony or Schleswig-Holstein) and a large number of the districts situated in the western part of eastern Germany (on the former inner-German border) have developed quite independently of the western/eastern German unemployment rate. This indicates that there may be different reasons for the independence from the aggregate movement. While southern Bavarian districts possibly benefit from their stable economic development, the eastern German districts on the former inner-German border clearly benefit from the good labour market conditions of their western German neighbours. On the other hand, urbanised areas as autonomous

9 The estimations were also carried out for western German regional employment office areas for the period 1989–2004. As regional employment office areas are large, homogenous regions the cyclical sensitivity coefficients are much less widely dispersed than those of districts and vary only within a range from 0.89 in Schleswig-Holstein/Hamburg to 1.19 in Hesse.

municipal authorities ('kreisfreie Städte') or districts in the Ruhr Area and western German districts situated close to eastern German districts have developed strongly procyclically. As urbanised areas constitute a large part of the economy, this result is in line with expectations, because it means that they are highly relevant for the development of both employment and unemployment. For the western German districts on the former inner-German border, the highly procyclical development reflects the additional influence of the neighbouring high-unemployment regions in eastern Germany.

Figure 9: Spatial distribution of the cyclical sensitivity parameter



The estimates above show that the cyclical sensitivity to the "national" unemployment rate varies greatly across districts and is often significantly different from unity. Nevertheless, the estimated constant for each region is often significantly different from zero, too. In the estimates the constant was significantly different from zero in 191 cases (in 115 districts significantly negative, in 76 significantly positive). The conclusion has to be that the national economic situation is important for explaining different regional economic developments but that there are regional conditions which can not be disregarded. In this sense, the decision between differences and ratios as relative regional variables characterizes a decision between two extremes: if all regions paralleled the national unemployment rate perfectly, the coefficient b_i in equation (14) should be equal to unity for all regions and the estimates should vary only in the constants. If instead all estimated constants were equal to zero, the regional unemployment rate could be perfectly expressed as a multiple of the national unemployment rate. Thus, if there were stable differences instead of stable ratios, the estimates should vary mainly in the constants, not in the parameter values for b_i. Obviously neither of these two extremes are confirmed by the data. The construction of region-specific variables in this paper follows Decressin/Fatás (1995). They are obtained by calculating the difference between the regional and beta times the national unemployment rate (beta-differences):

$$u_{it} = U_{it} - \hat{b}_i U_t \quad \textbf{(15)}$$

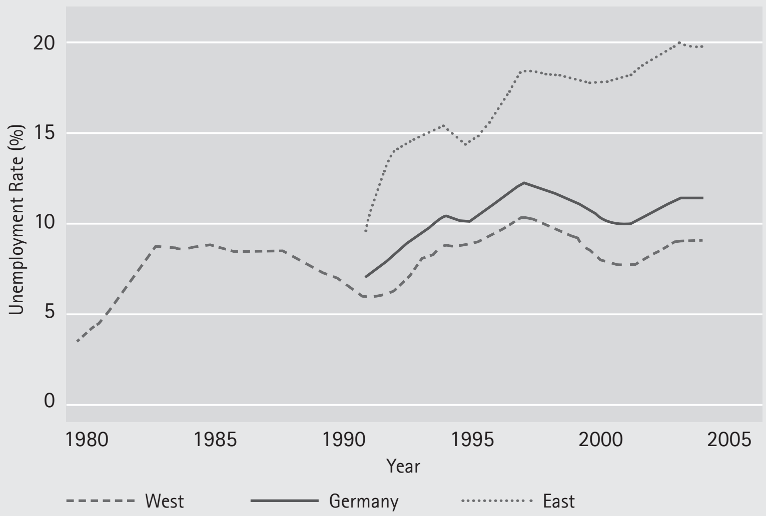
This concept can be interpreted as a mixture of the two extremes outlined above because the regional unemployment rate is only corrected for the part of the variation which is due to changes in the national rate. The remaining relative unemployment rate, u_{it}, can be regarded as a region-specific share of the unemployment rate. Therefore, we use beta differences to construct relative unemployment rates in the rest of the paper.

3.4 Disparities and persistence of unemployment rates

In this section, the disparities and persistence of unemployment rates across the 439 German districts are discussed. The aim of this section is to show that enormous disparities and strong persistence of district unemployment rates in Germany can be found for both absolute and relative unemployment rates.

The development of the unemployment rate in Germany and in the eastern and the western parts of the country can be seen in Figure 10:

Figure 10: Development of the German unemployment rate 1980–2004

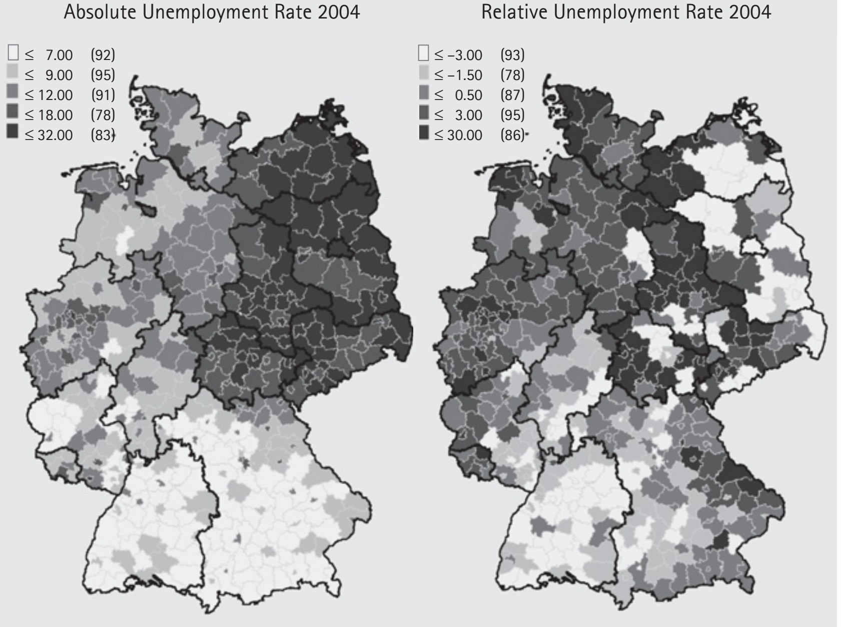


As already mentioned in the introduction, the (western) German unemployment rate has dramatically risen during the last decades. The second oil price shock at the beginning of the 1980s led to a sharp rise from 3.4 percent in 1980 to 8.7 percent in 1983. In the following years the situation on the labour market improved slowly and the unemployment rate reached a minimum of 6.8 percent in 1991. The 1990s were then affected by German reunification in 1989 and the German unemployment rate reached its peak in 1997 at 12.2 percent. The rate fell again to a level of 9.9 percent in 2001 during the "New Economy Boom" and has been rising since then. Apparently the unemployment rate recovered after each recession but did not reach its initial level again. This is even more striking for the eastern than for the western part of the country: the unemployment rate in eastern Germany has grown about twice as high as that in western Germany since the late 1990s. Figure 10 also suggests that the gap between the high-unemployment eastern and the low-unemployment western part of Germany is growing instead of showing the expected decline.

3.4.1 Disparities

To shed light on these disparities, a detailed disaggregated analysis of district unemployment rates in 2004 is provided in this section. In 2004, the unemployment rate in Germany as a whole amounted to 11.7 percent, but in the districts, it ranged from 3.7 percent in Eichstätt (Bavaria) to 31.9 percent in Uecker-Randow (Mecklenburg-Western Pomerania). The unemployment rate for all German districts in 2004 for the absolute and the relative measures can be seen in Figure 11.

Figure 11: Unemployment rates across German districts 2004



High (absolute) unemployment rates can be found primarily in the eastern part of Germany, the former German Democratic Republic (GDR). Here, the average unemployment rate in 2004 amounted to 20.1 percent, with a minimum of 12.2 percent in Sonneberg (Thuringia, on the border to Bavaria) and the maximum in Uecker-Randow (Mecklenburg-Western Pomerania) at 31.8 percent. Medium rates prevail in the northern and central western German Federal States including Schleswig-Holstein, Lower Saxony, North Rhine-Westphalia, Hesse, Rhineland-Palatinate and Saarland. Very low rates can be observed in the southern parts of Germany, i.e. Bavaria and Baden-Württemberg. The minimum unemployment rate amounts to 3.7 percent and is found in Eichstätt (Bavaria). Besides these patterns, city districts display noticeably higher unemployment rates than non-city districts, indicating that the centres of employment are also the centres of unemployment.

Relative unemployment rates also show a great variation between 18.7 percentage points in western Germany and 49.3 percentage points in the eastern part of the country. In western Germany the relative unemployment rates vary from –11.4 percent in the city district of Wolfsburg (Lower Saxony) to 7.2 percent in Essen (North Rhine-Westphalia). The minimum in eastern Germany amounts to –21.1 percent in Neubrandenburg (Mecklenburg-Western Pomerania) and the maximum is 28.2 percent in Dessau (Saxony-Anhalt). The distribution of relative unemployment rates shows that the region-specific share of the unemployment rates is larger in northern German districts, districts in eastern Germany situated on the former inner-German boarder and in the eastern part of Bavaria. Small region-specific shares can be assigned to southern Germany and to districts in the eastern part of eastern Germany.

3.4.2 Persistence

Persistence of unemployment can be measured in different ways. For an overview see e.g. Mikhail et al. (2003). In this section, one measure is applied to show the extent of persistence across German district unemployment rates.

One approach used to measure the persistence of regional unemployment rates is to look at the correlation between the rates of districts at different points in time. If unemployment rates tend to be persistent, a district with a low rate should remain at a low level, whereas a district with a high rate should not be able to lower its rate and should therefore maintain the high level. The correlation should therefore be positive. This positive correlation can be measured in different ways. The spearman rank correlation for the absolute and relative unemployment rates at different points in time can be seen in Table 3:

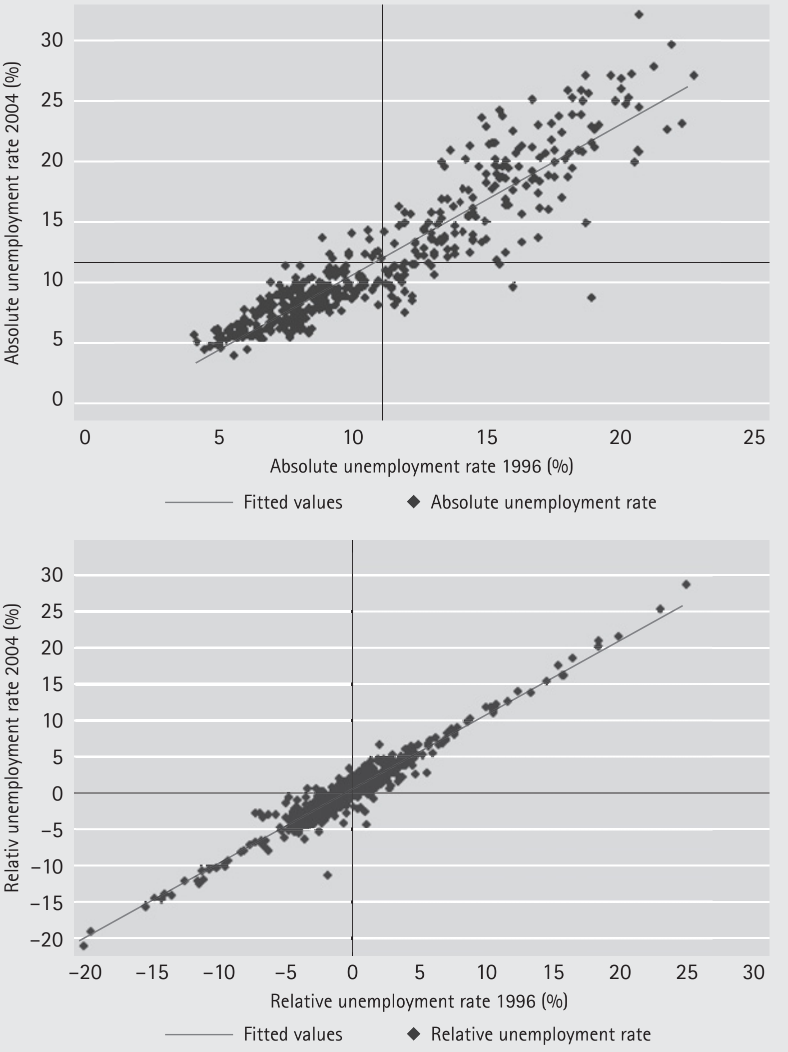
Table 3: Spearman rank correlation coefficients for absolute and relative unemployment rates in different periods

Period	1996–2004	1989–2004	1980–2004
Observations	East + West Germany: N = 439	West Germany: N = 326	West Germany: N = 326
Coefficient absolute unemployment rate	0.927***	0.822***	0.656***
Coefficient relative unemployment rate	0.928***	0.935***	0.819***
*, **, *** significant at the 10, 5 and 1 percent levels respectively.			

The rank correlation coefficients are all highly significant and clearly show the stability of the distribution over time. For the latest period for East and West Germany from 1996–2004 the correlation coefficient is 0.93 for both, the absolute and the relative unemployment rate. For the longer periods from 1989–2004 and 1980–2004 only data for West German districts were available. The results show that even for longer periods the coefficients are quite high. Especially the rank correlation coefficient for the relative, *ß*-corrected unemployment rate still amounts to 0.82 after nearly a quarter of a century. According to the results for longer periods in West Germany the relative, *ß*-corrected unemployment distribution seems to be still more persistent than the distribution of absolute unemployment rates.

To gain also an optical impression of this correlation, Figure 12 shows a scatter plot of the absolute and relative regional unemployment rates in 1996 and 2004 including a regression line and the average values of the respective year:

Figure 12: Persistence of regional unemployment rates (scatter)



The observations clearly show persistent behaviour and state the positive correlation already seen above: most districts that had a lower (higher) unemployment rate than the national average in 1996 (x-axes) were still better (worse) than the average in 2004 (y-axes).

For the absolute unemployment rate, only 16 districts (3.2 %) changed from below the national average to an above-average unemployment rate in 2004. These include 4 northern Bavarian city districts close to the former inner-German boarder (Kulmbach, Nuremberg, Bayreuth, Coburg). They all had to record almost a doubling of their unemployment rates during this time span. On the other hand, also only 23 districts (3.9 %) managed to improve from above to below the national rate. Put differently, this means that more than 90 percent of all districts kept their position relative to the national unemployment rate unchanged during the observation period. The regression line is highly significant with a slope of 1.25 and an R^2 of 0.85. These figures are approximately the same for the relative unemployment rates, where 25 districts changed from above to below the national average and 19 districts vice-versa. The slope of this estimation is 0.95 and the R^2 is 0.94. The higher R^2 of the latter estimation suggests that relative unemployment rates are still more persistent than their absolute counterparts.

In their estimates for Europe and the US, Decressin/Fatás (1995) found slopes of 1.18 and 0.17 with an R^2 of 0.32 and 0.17 respectively in regressions of the unemployment rate in 1987 on the unemployment rate in 1968. They concluded that the European unemployment rates are more persistent than those in the US. Because the time span and the regional level of the regressions above is not identical to those in Decressin/Fatás (1995), it is not possible to compare the results directly, but it is obvious that the estimated coefficient here is closer to Europe than to the US. Therefore the conclusion here is that German district unemployment rates are – similar to European unemployment rates – more persistent than US unemployment rates. This result is interesting in particular given the fact that both US states and German districts act under national conditions that are the same for all regional units in the country. Therefore this comparison already shows that regional factors in Germany might be responsible for the persistent behaviour of district unemployment rates.

To sum up, both absolute and relative unemployment rates display high disparities between German districts. Furthermore, simple measures already show that the unemployment rates exhibit strong persistent behaviour in the period from 1996–2004. The variation over this period was only little and most of the German districts kept their position relative to the "national" unemployment rate. The relative distribution seems to be even more persistent than the absolute values. Despite the rather limited length of the observation period, this is a first hint that persistent disparities might stem from a stable distribution of regional factors (such as the sectoral structure or the climate) that hardly vary over time. The investigation of a longer time period – particularly for more recent years – would be necessary to substantiate this finding, as regional as well as the national unemployment rate showed a strong reaction since the year 2005. But, the structural break in 2005 caused by the "Hartz-Reform" made this investigation unreasonable. Persistence of unemployment rates has been reported in many studies for Germany (cf. Möller 1995, Suedekum 2004, Blien 2003), and for other European counties (e.g. Badinger/Url 2002 for Austria, Epifani/Gancia 2005 for Italy, Evans and McCormick 1994 or Gray 2004 for Great Britain, Pehkonen/Tervo 1998 or Petteri 2003 for Finland), the whole of Europe (e.g. Decressin/Fatás 1995, Niebuhr 2003, Overman/Puga 2002, Suedekum 2005) or the U.S. (e.g. Neuman/Topel 1991, Vedder/Gallaway 1996).

Given the observed persistent unemployment differentials for both absolute and relative values, the next question to be answered is where these disparities come from. Are they natural in structure, i.e. a stable spatial distribution, or are they due to slow-working adjustment mechanisms in the aftermath of aggregate or region-specific shocks? The first part of the next section shows that both absolute and relative unemployment rates converge towards a stable spatial distribution of unemployment disparities but not towards the aggregate mean. In the second part, impulse responses to aggregate and region-specific shocks are used to demonstrate that slow-working adjustment mechanisms do not prove to be responsible for these differences.

3.5 Unemployment dynamics

As shown in section 3.4, the distribution of regional unemployment rates displays strong persistent behaviour. This result holds despite the great variance between districts. There might be tendencies to equalize regional disparities in the unemployment rate. Adjustment mechanisms like the migration of labour or firms are possible candidates for counteracting persistent disparities. Therefore, the next question to answer is whether there are mechanisms that remove this persistence and lead to a convergence of regional unemployment rates or whether instead the disparities remain stable or even tend to increase. In this section, we examine the dynamics of the absolute and relative regional unemployment rates to see whether

- regional unemployment rates form a stable spatial distribution
- the adjustment patterns have changed over time
- there are differences between smaller and larger spatial units.

3.5.1 Convergence or divergence?

The focus of this section is to explore the development of regional unemployment rates across regions and districts. In more detail the question is whether regional unemployment rates converge towards a national or a region-specific unemployment rate or whether instead divergent forces according to the geographical economics models proposed in Krugman (1991a) and Krugman/Venables (1995) can be found. Since the influential work of Barro/Sala-i-Martin (1991), the question of the convergence or divergence of regions has been a subject of controversial discussion in the theoretical and empirical literature (see for example Sala-i-Martin 1994, Quah 1996, Armstrong/Vickerman 1995). In recent years, regional models to explain divergent forces in the regional unemployment rates have been developed for example in Epifani/Gancia (2005) or Suedekum (2004) and (2005).

Barro/Sala-i-Martin (1991) emphasised two different concepts of beta-convergence in their work: unconditional and conditional convergence. If there is unconditional convergence, all units converge towards the same equilibrium, whereas in the case of conditional convergence, each unit converges towards its own steady state. Barro/Sala-i-Martin (1991) also introduced the concept of sigma-convergence in their work, which is given if the variation in the distribution of regional unemployment rates decreases over time. They state that beta-convergence is necessary but not sufficient for sigma-convergence.

To see this, let the unemployment rate of economy $i = 1 \ldots, N$ be

$$u_{it} = a + (1 - \beta)\, u_{it-1} + \varepsilon_{it} \tag{16}$$

where $0 < \beta < 1$ and ε_{it} has mean zero, finite variance σ_ε^2 and is independent over i and t. Manipulating (16) yields

$$u_{it} - u_{it-1} = a - \beta\, u_{it-1} + \varepsilon_{it} \tag{17}$$

Thus, $\beta > 0$ implies a negative relationship between the development of the unemployment rate in a region and its initial unemployment rate. If a is equal across regions the system displays absolute convergence towards the same unemployment development a. If a is instead different across regions, i.e. $a_i \neq a_j$, each region converges towards its specific unemployment development a_i known as conditional convergence. The variance of the unemployment rate across regions then equals

$$\sigma_t^2 = \frac{1}{N} \sum_{i=1}^{N} (u_{it} - \mu_t)^2 \tag{18}$$

with μ_t as national unemployment rate. For large N the sample variance is close to the population variance and (18) can be written as

$$\sigma_t^2 \cong (1-\beta)^2 \sigma_{t-1}^2 - \sigma_\varepsilon^2 \qquad \textbf{(19)}$$

Only for $0 < \beta < 1$ the difference equation is stable, i.e. beta-convergence is necessary for sigma-convergence. For all other values of β, the variance would either increases over time ($\beta < 0$), move as random walk ($\beta = 0$), be constant ($\beta = 1$) or oscillate over time and would thus be non-converging. But, also if beta-convergence is at work, sigma-convergence must not necessarily apply if the variance of random shocks σ_ε^2 is large compared to the dispersion of regional unemployment rates. Intuitively, regional unemployment rates might be beta-converging while massive random shocks are pushing them apart and ending up in a larger dispersion of regional unemployment rates. Thus, beta-convergence is necessary but not sufficient for sigma-convergence.

We focus on the different forms of beta-convergence in this section. The tests for conditional and unconditional beta-convergence, i.e. the convergence of regional unemployment rates towards a region-specific or the national mean, are carried out using panel unit root tests and a fixed effects autoregressive estimation, respectively.

An approach to testing empirically for conditional beta-convergence is to employ panel unit root tests: as mentioned above, conditional convergence implies that a variable returns to its region-specific value after an adverse shock. In the times-series literature the behaviour of a variable returning towards a specific value is called stationarity[10] and is tested using unit root tests. In the other case – if a variable is not attracted by a specific value – the variable is said to be non-stationary and displays hysteresis. Thus, if regional unemployment rates display conditional convergence, they should be stationary and vary only in the region-specific constants. In recent years, a variety of tests with different properties have been developed. Panel unit root tests of the first generation were developed to gain statistical power compared to their univariate counterparts (e.g. the augmented Dickey-Fuller test, Philips-Peron test, …), which are often not able to reject the null of nonstationarity even for variables that are known to be stationary. But, testing for stationarity using panel data is quite complex and assumptions that are met in the first generation panel unit root tests are too restrictive. As panel units typically show a substantial amount of unobserved heterogeneity, i.e. region specific variation, and are typically correlated among each other (facts that are ignored in the first generation tests), a second generation of tests has been developed that are able to account for these factors. Breitung/Pesaran (2006) provide a good review of the recent literature. In

10 In statistical terms, stationarity is given if a stochastic process has constant expected value, variance and covariance.

accordance with the testing procedure used by Bayer/Juessen (2007) and due to a lack of testing procedures for the second generation tests in statistical software packages, the common first-generation tests of Levin/Lin/Chu (2002) and Im/Pesaran/Shin (2003) are used to test for conditional convergence. In a second step, the hypothesis of unconditional convergence is tested by applying a fixed effects autoregressive model.

The basic regression used in both tests (LLC and IPS), is

$$\Delta y_{it} = \rho_i y_{i,\, t-1} + \sum_{k=1}^{K} \phi_{ik} \Delta y_{i,\, t-k} + z_{it}' \gamma_i + \varepsilon_{it} \qquad \textbf{(20)}$$

where the lagged differences of y_{it}, $\Delta y_{i,\, t-k}$, control for serial correlation between the ε_{it} and the vector z_{it} may be empty or include a constant term, fixed effects or a time trend into the regression. Also the null hypothesis that $\rho_i = 0$ for all i, i.e. all time series are independent random walks, is the same in the LLC and the IPS test. Thus, both tests use the same basic regression and the same null hypothesis. They differ only in the underlying alternative hypothesis specification. LLC specify a homogenous alternative, where all ρ_i are equal and significantly negative, i.e. all time series are stationary, whereas IPS test the less restrictive heterogeneous alternative, where ρ_i may differ across regions and only a significant proportion of all time series is stationary.

Given the disparities in the distribution of the absolute and relative unemployment rates seen in Figure 11, the question is whether German unemployment rates show conditional or even unconditional convergence. Determining the optimal lag length of equation (20) is usually done by means of sequential t-tests. These tests have been performed e.g. in Möller (1995) or Bayer/Juessen (2007). Both authors report an optimal length of two lags. We consider these results as sufficient evidence for an optimal lag length of two years and use also use a maximum lag length of two years ($k = 2$) in our estimates. Because of the differentiation and the inclusion of lagged differences, 3 observations are lost for each panel unit and for $k = 2$, 13 observations per unit remain. According to Breitung/Pesaran (2006) both tests are asymptotically efficient for more than six time periods ($T > 6$) if the number of cross-sections, N, tends to infinity. The results for LLC and IPS on conditional convergence, i.e. equation (20) estimated with fixed effects for each region/district, can be seen in Table 4:

Table 4: LLC and IPS tests for conditional convergence

Levin, Lin and Chu (LLC)					Im, Pesaran and Shin (IPS)			
Lags	Obs.	Coeff.	t_{star}	$P>t_{star}$	Lags	Obs.	$W(t_{bar})$	$P>t_{bar}$
Absolute unemployment rates								
Regions, 1989–2004								
0	105	–0.351	–2.359	0.009***	0	105	–1.708	0.044**
1	98	–0.468	–3.531	0.000***	1	98	–3.333	0.000***
2	91	–0.526	–0.739	0.230	2	91	–1.924	0.027**
Districts, 1989–2004								
0	4890	–0.267	–8.836	0.000***	0	4890	–3.741	0.000***
1	4564	–0.267	–10.386	0.000***	1	4564	–3.721	0.000***
2	4238	–0.267	–11.936	0.000***	2	4238	–5.230	0.000***
Relative unemployment rates								
Regions, 1989–2004								
0	105	–0.251	–1.993	0.023**	0	105	–0.530	0.298
1	98	–0.352	–3.311	0.001***	1	98	–1.790	0.037**
2	91	–0.437	–2.518	0.006***	2	91	–1.692	0.045**
Districts, 1989–2004								
0	4890	–0.374	–11.195	0.000***	0	4890	–9.189	0.000***
1	4564	–0.374	–12.953	0.000***	1	4564	–8.976	0.000***
2	4238	–0.374	–14.711	0.000***	2	4238	–0.336	0.000***
*, **, *** significant at the 10, 5 and 1 percent levels respectively.								

For the absolute unemployment rates of regions in the period 1989–2004, the LLC test rejects the null of non-stationarity safely if no or one lag is included, whereas the IPS test rejects the null in all different settings. This result also holds for relative unemployment rates where only the IPS test without a lag is insignificant. The estimated coefficient for ρ shows the expected negative sign in all settings. Thus, the results of both tests indicate stationarity of regional unemployment rates, meaning that they converge towards a stable pattern of unemployment differentials.

The estimated half-life of a shock can be calculated from the coefficient of the LLC test as $ln(0.5)/ln\ (1-\rho)$. According to our results for the medium coefficient (1st lag), a shock to absolute unemployment rates has an estimated half-life of only 1.1 years whereas for relative unemployment rates it takes 1.6 years for 50 percent of the shock to disappear. Thus, region-specific shocks take longer to disappear than absolute shocks. Bayer/Juessen (2007) estimated panel unit root tests for the unemployment rates of 10 West German Federal States in the period 1960–2002. They also found evidence of conditional convergence and a coefficient of $\rho = -0.117$ which implies a half-life of a shock of approximately 5.5 years. As Bayer/Juessen (2007) used simple differences ($u_{it} = U_{it} - U_t$) instead of beta-differences and additionally estimated for a different period and different regions, their results are not comparable to our estimates. However, Bayer/Juessen (2007) also demonstrate that the estimated half-life is upwardly biased if structural breaks in the data are omitted. By including a structural break, they find half-life periods in a range of 1–3 years for single Federal States. As the results of Bayer/Juessen (2007) with the inclusion of structural breaks are similar to our findings, the conclusion is that regions adjust quite rapidly to their region-specific means.

In the case of districts, both tests clearly reject the null of non-stationarity for all different lag lengths with t_{star} becoming more negative the more lags that are included. The estimated coefficients of $\rho = -0.267$ for absolute and $\rho = -0.374$ for relative unemployment rates implies half-lives of 2.2 and 1.5 years, respectively. Thus, the estimation results indicate stationarity of district unemployment rates, meaning that they converge towards a stable pattern of unemployment differentials for absolute and relative values. The investigation and interpretation of the adjustment paths for the different regional levels, i.e. shape and duration of the adjustment curve, is not the major object of this part and therefore conducted in the following section.

The stronger concept of convergence is to test for unconditional convergence, i.e. all districts converge towards the same (national) equilibrium. Here, unconditional convergence is tested by estimating a fixed effects autoregressive model of the form

$$u_{it} = a_i + b_i u_{it-1} + e_{it} \tag{21}$$

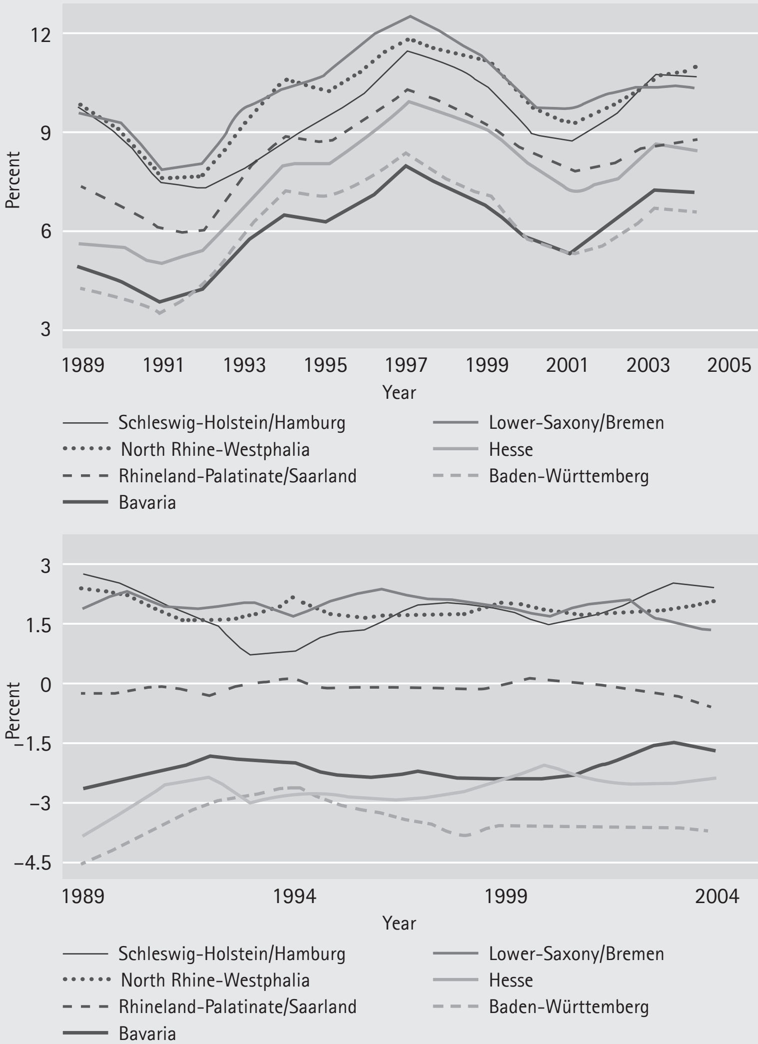
where the fixed effects a_i are tested for joint significance. The results are displayed in Table 5:

Table 5: Fixed-effects autoregressive model for unconditional convergence

Absolute unemployment rates							
Regions, 1989–2004 (105 observations, $R^2 = 0.646$)							
Var.	Coef.	T	P > t	F-test	Stat.	F	P > F
Cons	1.787	3.62	0.000***	Model	F(1.97)	178.98	0.000***
Lag 1	0.796	13.38	0.000***	FE	F(6.97)	0.93	0.475
Districts, 1989–2004, 1989–2004 (4889 observations, $R^2 = 0.552$)							
Var.	Coef.	T	P > t	F-test	Stat.	F	P > F
Cons	2.189	29.06	0.000***	Model	F(1.4889)	6022.69	0.000***
Lag 1	0.724	77.61	0.000***	FE	F(325.4889)	2.11	0.000***
Relative unemployment rates							
Regions, 1989–2004 (105 observations, $R^2 = 0.631$)							
Var.	Coef.	T	P > t	F-test	Stat.	F	P > F
Cons	–	–1.22	0.226	Model	F(1.97)	165.79	0.000***
Lag 1	0.730	12.88	0.000***	FE	F(6.97)	3.58	0.003***
Districts, 1989–2004 (4889 observations, $R^2 = 0.405$)							
Var.	Coef.	T	P > t	F-test	Stat.	F	P > F
Cons	–	–28.39	0.000***	Model	F(1.4889)	3323.97	0.000***
Lag 1	0.547	57.65	0.000***	FE	F(325.4889)	6.07	0.000***
*, **, *** significant at the 10, 5 and 1 percent levels respectively.							

The F-tests for the different models (first row on the right, F-test model) as well as the first lags (Lag 1) are highly significant in all estimates (regions and districts). The F-test of the AR(1) model (second row on the right, F-test FE) rejects the null hypothesis that all fixed effects are zero, but only in three out of four settings: in both estimates for relative unemployment rates and for the absolute values of districts. Therefore, for these estimates one can conclude that at least one fixed effect is significantly different from zero, indicating conditional rather than unconditional convergence. For the absolute unemployment rates of regions, the F-test that all fixed effects are zero cannot be rejected. As absolute convergence of absolute unemployment rates would necessarily imply also absolute convergence of relative unemployment rates (if all regions display the same unemployment rate, all relative rates are one), we look at this result in more detail. The absolute and relative unemployment rates of regions in the period 1989–2004 are displayed in Figure 13:

Figure 13: Absolute and relative unemployment rates of regions



The absolute unemployment rates of regions clearly follow a cyclical development. They display an almost parallel development over time. This development is obviously captured entirely by the first lag of the AR(1) estimation. Therefore, no region-specific constants are necessary, which implies convergence towards the national mean. Relative unemployment rates, however, are corrected for variations due to aggregate factors. They hardly vary over the observed period and show approximately horizontal lines at different levels captured by significant regional fixed effects in the estimation. As mentioned above, absolute convergence means that the distribution of unemployment rates becomes more even over time.

According to Figure 13 this can not be found for absolute unemployment rates. The development over the period 1989–2004 rather suggests that both absolute and relative unemployment rates move within a region-specific distance around the national average. Hence, we conclude from this examination that both the absolute and relative unemployment rates of regions display conditional rather than unconditional convergence.

Comparing the results for conditional and unconditional convergence shows that the concept of conditional convergence is more likely than unconditional convergence for western German unemployment rates. According to the estimates, 50 percent of both region-specific and aggregate shocks disappear within approximately 1–2 years in the observation period of 1989–2004. Therefore, the main conclusions that can be drawn from these empirical investigations are the following: both the absolute and the relative β-corrected unemployment rates of both regional levels (regions and districts) display convergence towards their region-specific means and therefore towards a stable distribution of regional β-corrected unemployment disparities. This result is due to an adjustment mechanism that leads to a convergence of each spatial unit towards its steady-state unemployment rate. Thus, highly persistent regional unemployment disparities as seen in Figure 13 can be regarded as region-specific unemployment rates due to different regional endowments, adjusting quite rapidly to their region-specific means, but not towards the national unemployment rate.

This result raises the question of how long the complete adjustment process after aggregate and region-specific shocks lasts and what shape the adjustment curve of the regional unemployment rate takes on. These questions are approached by estimating impulse responses to shocks in the following section.

3.5.2 Adjustment to shocks

In this section, the time it takes for a shock in the regional unemployment rate to settle is calculated using a dynamic panel model and displayed as an impulse response function. In addition to the time-space combinations used in section 3.5.1, we estimate an impulse response for regions for the period 1966–1987. This enables us to compare the results directly with the analysis conducted by Decressin/Fatás (1995). All of the estimates are carried out with two lags and include a fixed effect for each region/district.[11] The equation to be estimated is:

11 Test results for the optimal lag length (AIC-/BIC-Criteria) across regions and districts indicate differences in the underlying lag structures. But, a common result across all test results is that at least two lags have to be included. Therefore and in order to compare our results to the estimations of other authors, we also used two lags in all estimations.

$$u_{it} = a_i + b_i u_{it-1} + c_i u_{it-2} + e_{it} \tag{22}$$

where a_i is the individual regional fixed effect. Because the ordinary Least Squares Dummy Variable estimator (LSDV) is biased and inconsistent in this case (see Kiviet 1995, 1999), the bias-corrected LSDV estimator proposed by Bruno (2004) is applied.

To analyse the impact of both aggregate and regional shocks the model is estimated for absolute and relative unemployment rates. The results for regions and districts can be found in Table 6.[12]

Table 6: Adjustment of regional unemployment

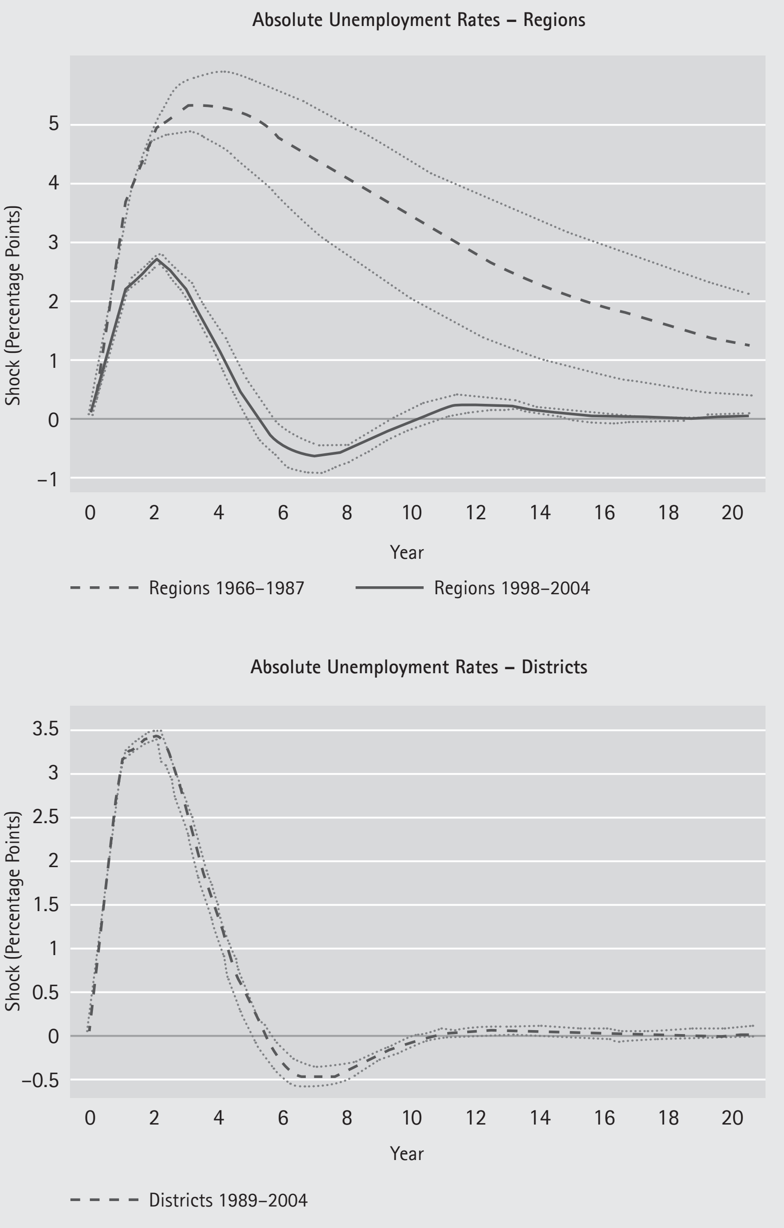
Region	Period	Panel units	Abs. unemployment		Rel. unemployment	
			Lag 1	Lag 2	Lag 1	Lag 2
Regions						
West Germany	1966–1987	7	1.406	–0.453	1.052	–0.341
West Germany	1989–2004	7	1.247	–0.596	0.955	–0.411
Districts						
West Germany	1989–2004	326	1.112	–0.460	0.796	–0.175

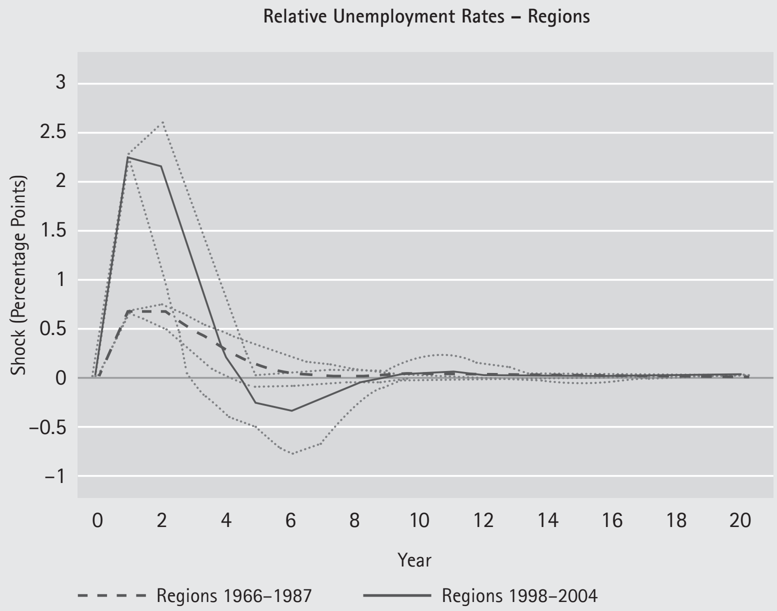
The corresponding adjustment processes for regions and districts after a positive shock to regional absolute and relative unemployment rates are displayed in Figure 14. The corresponding 95 %-confidence intervals are plotted as dotted lines.[13] As the aim is to compare regional units with different levels of unemployment rates, we construct shocks as one-standard deviations of all observations in each panel. This allows us to compare the regional units with respect to both the magnitude of the region-specific-shocks and the time it takes to reach the initial level again.

12 The cyclical sensitivity coefficients for regional employment office areas were estimated for each period separately.

13 The 95 %-confidence intervals were generated by bootstrap methods and are based on 1,000 replications of each estimation, see e.g. Efron/Tibshirani (1993).

Figure 14: Adjustment of regional unemployment




Relative Unemployment Rates – Regions
3
2.5
2
1.5
1
0.5
0
–0.5
–1
Shock (Percentage Points)
0
2
4
6
8
10
12
14
16
18
20
Year
Regions 1966–1987
Regions 1998–2004

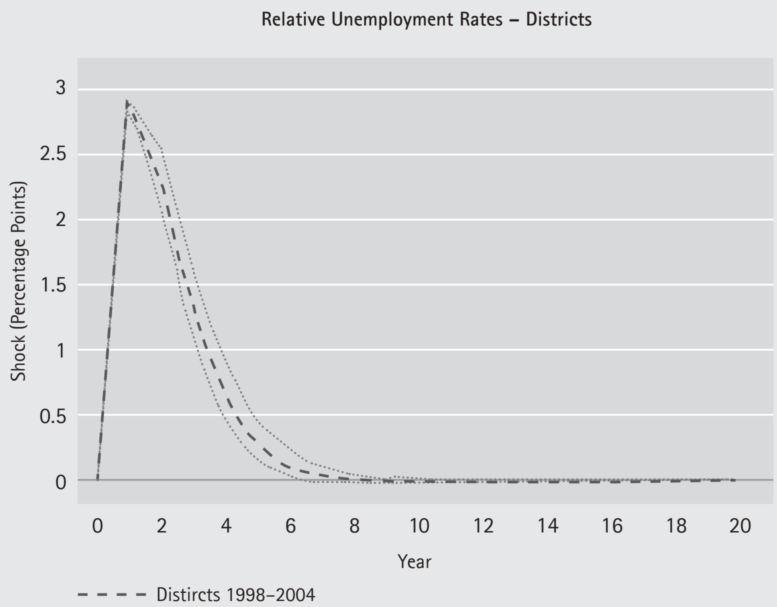

Relative Unemployment Rates – Districts
3
2.5
2
1.5
1
0.5
0
Shock (Percentage Points)
0
2
4
6
8
10
12
14
16
18
20
Year
Distircts 1998–2004

Figure 14 contains 4 graphs: they present the adjustment of absolute and the adjustment of relative unemployment rates separately for regions as well as for districts. Period one always represents the initial shocks. The estimates for regions in the two different periods show that shocks to absolute unemployment have decreased whereas shocks to relative unemployment have increased during the last decades. As the shocks are created as one-standard deviations, it follows that the variation across regions has decreased for absolute rates and increased for the relative measure. Thus, shocks to relative unemployment have gained importance compared with shocks to absolute unemployment.

According to Decressin/Fatás (1995) the adjustment of unemployment rates in the US lasts about 10 years for absolute and 6 years for relative unemployment rates, whereas the corresponding values for Europe are far more than 15 years for absolute but only 3 years for relative unemployment rates. They therefore conclude that aggregate shocks lead to the persistence of unemployment rates known in European countries and that this is not the case in the US. For Europe, Decressin/Fatás (1995) use unemployment rates for the period 1966–1987. A look at the same observation period for regions in Germany confirms their findings: absolute unemployment rates take more than 20 years to return to their initial value and relative unemployment rates get insignificant after only about 4 years. If the estimation is carried out for the period 1989–2004, it can be observed that the adjustment process of absolute unemployment is similar to that estimated for relative unemployment rates and that the adjustment duration for both measures is about 3–4 years. Therefore, the conclusion reached by Decressin/Fatás (1995) holds only for the period 1966–1987. These results show on the one hand that the estimated speed of adjustment depends strongly on the underlying observation period. On the other hand, for western Germany we can conclude that the degree of persistence of the unemployment rate due to aggregate shocks has decreased substantially during the last decades. Region-specific shocks, in contrast, did not have permanent effects in previous periods and shocks are still less persistent in present times. In the case of districts neither aggregate nor region-specific shocks show persistent behaviour in the period 1989–2004 and display an adjustment duration for both measures of about 4–5 years.

Considering both regional levels, the most important finding is that unemployment rates adjust fairly quickly after a district/region is hit by a negative shock. According to Figure 14, the half-life of a shock is in a range of about two to three years for both aggregate and region-specific shocks for the two regional levels. This result indicates that regional adjustment mechanisms work well for unemployment rates in the observation period 1989–2004. With regard to aggregate shocks, the time it takes for the unemployment level to return to its initial level is about four years for both regional levels. However, the time it takes for a region-specific shock to disappear entirely is about seven years for districts whereas regions adjust within about four years. This stronger effect for districts demonstrates that smaller spatial units react more sensitively to region-specific shocks than larger spatial units. A reason for the larger sensitivity of districts might be found in the sector structure. As districts are smaller than regions, they do not have as large possibilities to react to a region-specific shock by a shift in the sector structure.

The conclusions from this section are as follows:

The degree of persistence in the absolute unemployment rates in western Germany has decreased markedly during the last decades. Region-specific shocks did not leave permanent effects in previous periods and are still less persistent in present times. Thus, the results found by Decressin/Fatás (1995) for the period 1966–1987 are confirmed, but the data show that they are no longer valid for more recent years. Therefore, their conclusion that aggregate shocks are responsible for the persistent effects known in Europe (and also in western Germany) must be reformulated: both aggregate and region-specific shocks have not been responsible for the persistent behaviour of unemployment rates in the last 16 years. This result also holds for districts.

As already seen in section 3.5.1, both absolute and relative unemployment rates adjust fairly quickly and display half-lives of a shock lasting about two to three years. This result holds for regions and districts. As unemployment rates do not exhibit convergence towards the national mean, slow-working adjustment mechanisms in response to shocks are not responsible for persistent unemployment differentials as described above. The remaining alternative explanations for these disparities are: first, region-specific shocks are not independent from each other and hit predominantly the same regions to maintains these spatial disparities. Second, regional unemployment disparities are driven by other factors and constitute an equilibrium phenomenon. The latter is the more probable alternative given the observed permanent effects of aggregate shocks in earlier decades (mainly the 1960s and 1970s). As there is no tendency for differentials built up during this time to decrease (there is no convergence towards the national mean), the observed disparities remain (and constitute a new stable distribution of regional unemployment rates) although the adjustment mechanisms performed well during the last decades.

3.6 Conclusions of univariate models

The analysis of the unemployment rate in section 3 shows that the distribution of unemployment rates at district level in Germany exhibits strong persistent behaviour. Unemployment rates display an enormous range across the country but hardly vary over time for most of the districts. The relative distribution seems to be even more persistent than absolute values. These findings are similar to those found for most European countries but contrast sharply with those for the US, where unemployment rates are hardly persistent. This result holds given the fact that US states and German districts act under national conditions that are the same for all regional units within the country.

Panel unit root tests indicate that both the absolute and the relative unemployment rates of regions and districts display convergence towards their region-specific means and therefore towards a stable distribution of regional unemployment disparities. This result is due to an adjustment mechanism that leads to a convergence of each spatial unit towards its steady-state unemployment rate. Thus, highly persistent regional unemployment disparities can be regarded as region-specific unemployment rates due to different regional endowments, adjusting quite rapidly to their region-specific means, but not towards the national unemployment rate.

The investigation of adjustment processes suggests that the degree of persistence in the absolute unemployment rates in western Germany has decreased markedly during the last decades. Thus, the results found by Decressin/Fatás (1995) are confirmed for the period 1966–1987 but are no longer valid for more recent years. Therefore, our conclusion is that neither aggregate nor region-specific shocks have been responsible for the persistent behaviour of unemployment rates in the last 16 years. This result also holds for districts. Therefore, slow-working adjustment mechanisms in response to shocks are not responsible for the persistent unemployment differentials.

Taking these results together, there is no tendency for differentials between spatial units that grew in earlier periods to decrease, although adjustment mechanisms performed well during the last decades. This is a strong indication that the distribution of unemployment rates found above remains stable for long periods of time.

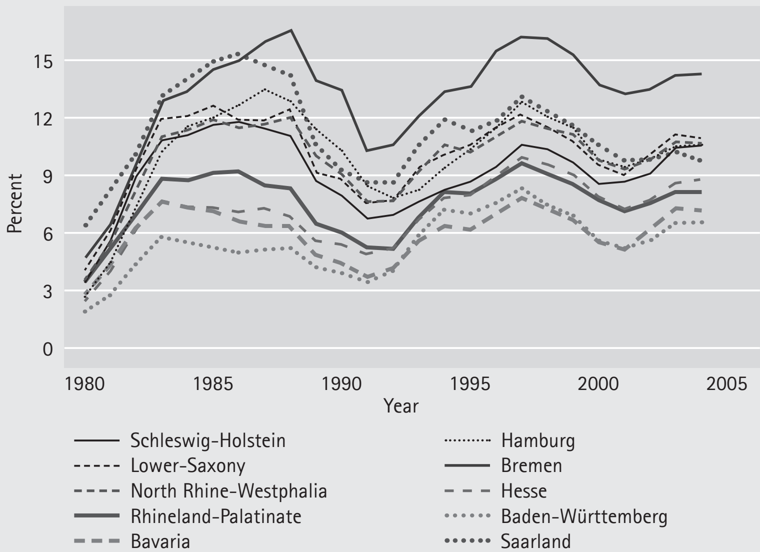
Comparing the results obtained for regions and districts shows ambivalent results for panel unit root tests and impulse response estimates with respect to the adjustment duration. But, as all of the estimated half-lives – for both regions and for districts – are found to be very robust within a range from 1–3 years, our conclusion is that the adjustment processes of districts and regions do not differ markedly.

4 Unemployment dynamics in West Germany – a simultaneous approach

Although the duration of adjustment is found to be very similar for regions and districts within 1–3 years, the underlying adjustment mechanisms may differ substantially. These mechanisms, i.e. the question how regions and districts adjust after the occurrence of a labour demand shock, are the focus of section 4.

The observation of persistent unemployment disparities holds also for German regions. The development of the unemployment rate across West German Federal States (NUTS1) can be seen in Figure 15:

Figure 15: Development of Federal States Unemployment Rates 1980–2004



As already seen for the national unemployment rate and for regional employment offices, regional unemployment rates recovered slightly after each shock, but they did not return to their initial level. Both, the second oil price shock at the beginning of the 1980s and the consequences of German reunification in 1989 led to a sharp rise in regional unemployment. As regions differ in their sector structure and exhibit different amenities, they react differently to common shocks and unemployment disparities seem to widen during recession years and narrow again in economically stable periods.[14] Given the moderate spread of 7 percent to

14 This holds at least for the observation period 1980–2004. During the latest finance crisis from 2008–2009, unemployment disparities narrowed as the finance crisis hit predominantly economically strong regions with low unemployment rate.

13 percent in the unemployment rates of Federal States in 2004 (see Figure 15), unemployment rates at district level (NUTS3) in Germany vary substantially, see section 3.4.1. Given these observations, regional unemployment disparities might be considered as a result of different adjustment paths of regions to shocks due to their different sector structure.

However, regions do not only react to common shocks, but also to region-specific shocks concerning some regions or possibly one single region only. Positive or negative regional labour demand shocks as the foundation or closure of a major employer have sustainable effects on regional variables and have gained importance during the last 40 years in Germany, see section 3. As the investigation of regional adjustment by Blanchard/Katz (1992) for the US and Decressin/Fatás (1995) for Europe and the US shows, adjustment to region-specific shocks differs substantially between Europe and the US. First, the long-run effect on a region´s employment share is much larger in the US than in Europe. Second, in the US, labour market shocks are immediately reflected in labour migration, whereas in Europe, the participation rate is the dominant equilibrating mechanism. If region-specific shocks in combination with slow working adjustment are responsible for persistent unemployment disparities, estimates at different regional levels can provide a sound view of commonalities and differences in the underlying processes. Therefore, the analysis of migration, commuting and regional adjustment is carried out at Federal States as well as at district level. There are good reasons, why smaller regional units should behave differently than larger regions. Districts, for example, can hardly be seen as closed labour markets. Migration and commuting activities between neighboring districts are more intense than in larger regional units, where much of this takes place inside the region. Thus, the adjustment after a region-specific shock should be much more reflected in interregional migration or commuting and less in changes in the unemployment and the participation rate. As especially the effect of commuting is usually ignored in the adjustment literature, this paper sheds light on this issue by tracing the effects of different shocks to the regional labour market: first, shocks to the employment growth rate at the place of residence are used to measure the extent of migration in the regional adjustment process. Second, shocks to the employment growth rate at the place of work are used to calculate the same effect if additionally commuting activities are considered.

The aim of this paper is to study adjustment processes in the aftermath of a region-specific shock. As the effects should differ between regional levels, adjustment behaviour at Federal States and district level in Germany is analysed. The questions that are addressed and answered in the empirical part of this section are: Are slow working adjustment mechanisms after a region-specific shock responsible for regional unemployment disparities? Which variables contribute to the adjustment process – the unemployment rate, labour force participation or labour mobility? Are the adjustment mechanisms at district level similar to those observed for larger regional units (e.g. Federal States)? Or do the different forms of labour mobility, i.e. migration and commuting activities, turn out to be more important? What happens to the unemployment and the participation rate in a region, if a shock in labour demand at the place of work – e.g. by the establishing of a new firm – takes place? Furthermore, how much of these new jobs are filled by immigration and incommuting? These questions can be best approached by applying the framework of Blanchard/Katz (1992) which basic ideas and implications were already presented in section 2.2. In section 4.5 evidence from the US, Europe and Germany is given to show the findings of other authors and the model of Blanchard/Katz (1992) is estimated for West German Federal States and districts in the period 1989–2004.

The rest of section 4 is organized as follows: In section 4.1 the theoretical background for regional adjustment dynamics is presented. In section 4.2 follows a brief description of the dataset used in this paper. Section 4.3 empirically investigates migration and commuting activities in Germany. Section 4.4 shows how region-specific variables are obtained and introduces the empirical framework. The joint movement of regional employment, unemployment and participation is the focus of section 4.5, and section 4.6 concludes.

4.1 A framework for regional evolutions

The observation of enormous regional disparities in the unemployment rate described above draws the attention to their potential origin: according to Frederiksson (1999) the comparatively stable pattern of regional unemployment disparities found in European countries may have different origins: First, these disparities constitute an equilibrium relationship. Second, aggregate as well as region-specific shocks occur in such frequencies that disparities remain although regional adjustment mechanisms exist to equilibrate those disparities and third, different reactions to common and region-specific shocks in combination with slow working adjustment mechanisms build and hold up regional disparities over long periods. An overview of theoretical and empirical research on regional unemployment differentials can be found in Elhorst (2003). According to these explanations, research on unemployment can be characterized as follows:

Most studies on regional unemployment concentrate on equilibrium explanations and use theoretical long-run relationships between unemployment and other variables like job vacancies (Beveridge Curve), the national unemployment rate (Cyclical Sensitivity model) or regional amenities (Amenity model) to investigate differences in regional unemployment. Other models of the equilibrium type as migration- or wage-setting-curve- (Phillips-Curve) based approaches use theoretical explanations, where the unemployment rate is not directly estimated, but can be calculated out of these relationships. A further approach is to use the labour market accounting identity: the labour market can be characterized by one equation, the labour market identity, where unemployment results out of the difference between labour supply and labour demand. Commonly, the different parts of the identity (working age population, participation rate, commuters or employment) are replaced by their theoretical functions.

Approaches that explicitly model the adjustment dynamics after the occurrence of shocks are were e.g. proposed by Karanassou/Snower (2000) and Blanchard/Katz (1992). The chain reaction theory proposed by Karanassou/Snower (2000) employes typical time-series elements and claims that labour market shocks are felt through time. Therefore in the chain reaction theory, the total response of unemployment to a labour market shock (the long-run elasticity) consists of the immediate response (the short-run elasticity) and the persistence (the cumulated short-run elasticities of all shocks over all periods). Thus, the chain reaction theory contains interprets unemployment series as a stochastic process that keeps the effect of a shock in memory. Another approach that explicitly deals with adjustment dynamics stems of Blanchard/Katz (1992). They present a framework of the regional economy which is – according to Elhorst (2003) – the most extensive regional model currently available. Therefore this model is chosen to analyse regional evolutions in this section.

As outlined in section 2.2.1, the model of Blanchard/Katz (1992) differentiates between adjustment due to the unemployment rate, the participation rate and interregional migration after a region is hit by a labour demand shock. But, especially in the case of small spatial units as districts, other forms of adjustment might become important. As already mentioned above, commuting is a possible candidate. In studies by Blanchard/Katz (1992), Decressin/Fatás (1995) or Möller (1995), the regional level of disaggregation is NUTS1 or larger (Federal States or regional employment offices), where much of the commuting activities takes place inside a region. In the case of districts instead, distances decrease substantially and commuting is a factor that can not be ignored (for a detailed discussion see section 4.3). The question answered by the model of Blanchard/Katz (1992) is: what happens if a region is hit by a labour demand shock? Which reaction shows the unemployment and the participation rate and how much of the permanent effect on employment is captured by migration? This seems to be sufficiently detailed if the level of disaggregation is NUTS1 or larger. In the case of districts instead, the commuter share in the regional labour market increases dramatically and the labour force of surrounding districts is involved. New jobs in a region might possibly not only be filled by the unemployed, new participants or migrants, but also by people who permanently live outside a district and commute to their work daily. Therefore, the distinction between the place of residence and the place of work of an employed person becomes relevant. We account for this distinction in our estimates to visualize the effect of commuting. More precisely we estimate the model in two different settings: First, we estimate the effects of a labour demand shock at the place of residence to unemployment, participation and migration. This setting answers the following question: Which reaction shows the unemployment and the participation rate at the place of residence and how much of the permanent effect on employment (at the place of residence) is driven by migration? Thus, a local effect is measured. Second, we estimate the effects of a labour demand shock at the place of work to the same variables than in the first setting. Following the model of Blanchard/Katz (1992) consequently, the permanent effect on employment – i.e. the part of the shock that is not absorbed by unemployment or participation – is then captured by migration and commuting. Thus, this approach is able to account for both, migration and commuting activities in the adjustment process and enables us to answer the following questions: what happens to the unemployment and the participation rate in a region, if a shock in labour demand at the place of work – e.g. by the establishing of a new firm – takes place? Furthermore, how much of these new jobs are filled by immigration and incommuting? As is makes a big difference for the job opportunities of workers at the place of residence, if e.g. 20, 50 or 80 percent of these new jobs are filled by immigration and incommuting, the estimation results are also highly relevant for decision makers in politics and economics.

4.2 Regional Data

The data set used in this paper is provided by the German Federal Employment Agency and the German Statistical Office. Variables obtained from the Federal Employment Agency are employment, unemployment and commuting figures. Data from the German Statistical Office contain migration and age groups of regional population figures. All series are on an annual basis. Unemployment rates from 1980–2004 at Federal States level presented in Figure 15 are official figures and are calculated as unemployed over the dependent labour force.[15] In section 4.3, regional unemployment rates, migration and commuting figures for all German districts in the year 2004 are used to analyse the potential that these variables

15 For the years 1980–1989, the dependent labour force was estimated from the German "Mikrozensus". For the years 1989–1999, the dependent labour force contains employees obliged to the social security contributions, civil servants, unemployed, expatriates and (underestimated) estimations for marginal employees from the "Mikrozensus". Since the year 2000, marginal employees are covered by the social security system and therefore available as official figures in the dependent labour force.

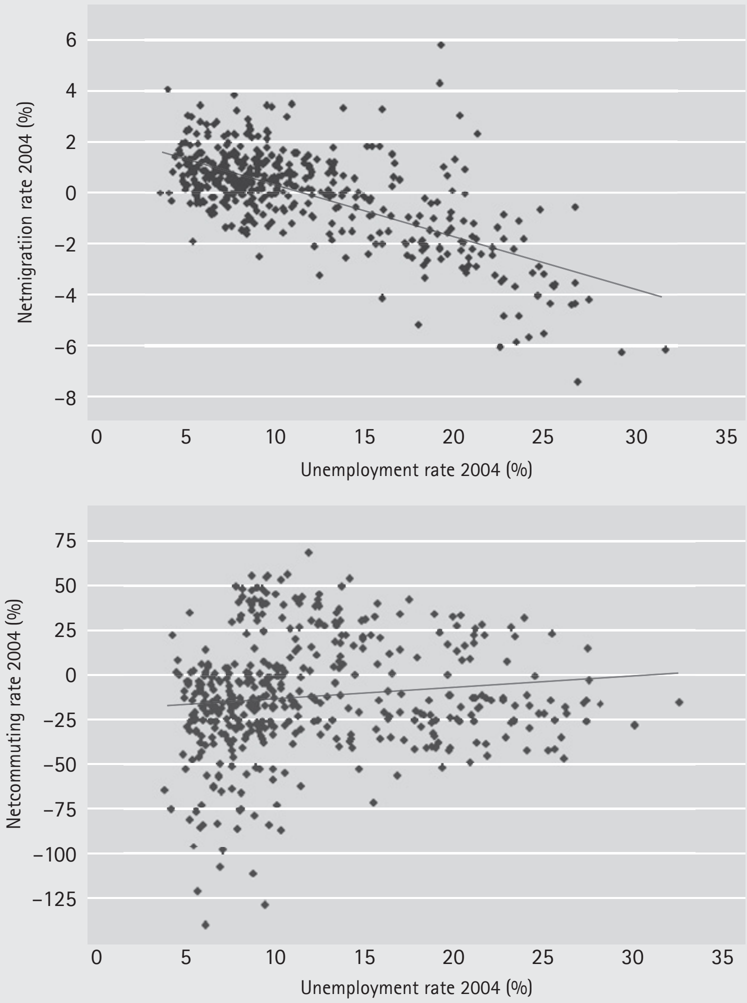
might have for regional adjustment processes. Migration is thereby defined as move of the residence across a district boarder and commuting is given if a person works in another district than in its place of residence. The estimation of regional adjustment processes in section 4.5 is carried out for West German districts and Federal States. The dataset consists of employment figures at the place of residence and at the place of work, the number of unemployed and the working age population from 1989–2004. The employment level contains only people covered by the social securitiy system ("sozialversicherungspflichtig Beschäftigte"). The working age population is calculated as a regions` population in the age of 15–64 years. From these series all other variables needed for the estimation (employment growth rates, employment rates, participation rates) can be calculated. For comparisons with larger regional units used in other studies, district data are aggregated on Federal States level. Due to a lack of consistent time-series for the former Eastern part of Berlin, the City State Berlin is excluded from the estimates in section 4.5.

4.3 Migration and commuting activities in Germany

This section empirically analyses, why districts should adjust differently than larger regional units. As already mentioned in sections 4 and 4.1, distances between districts are much lower than between Federal States. Mobility that takes place inside larger regional units becomes visible if districts are the object of analysis. Therefore, migration and commuting activities should be much larger for districts than for Federal States. For this reason, the relationship between net migration, net commuting and the regional unemployment rate is investigated. Additionally, different figures to measure the intensity of migration and commuting are calculated for districts and compared to the Federal States level.

As the main focus of this paper is the existence of enormous unemployment disparities described already in section 3, we are interested in the relationship between migration and commuting figures. A common statement in the German migration literature is that migration steadily flows from East to West Germany since German reunification in 1989. Alecke/Untiedt (2000), Hunt (2000), Burda/Hunt (2001) or Parikh/Van Leuvensteijn (2002) found this result for the first ten years of transition. But, as Burda (2005), Snower/Merkl (2006) or Uhlig (2007) show, substantial East/West migration is still present even more than 15 years after German reunification. According to theses studies, the reasons for this development are persistent regional disparities in e.g. nominal wages, unemployment rates or labour productivity between the two parts of Germany but also gradually shrinking subsidies. In all papers, the unemployment rate is thereby negatively related to net migration. Results for a relationship between net commuting and regional unemployment are instead not available for Germany to our knowledge. Figure 16 displays two scatter plots including a regression line for first, the net migration rate and second, the net commuting rate against the unemployment rate for 439 German districts in 2004.[16] For both measures, employment at the place of residence is used as denominator to show the extent of migration and commuting in relation to the persons actually working in the respective district.

Figure 16: Netmigration, netcommuting and unemployment of districts in 2004

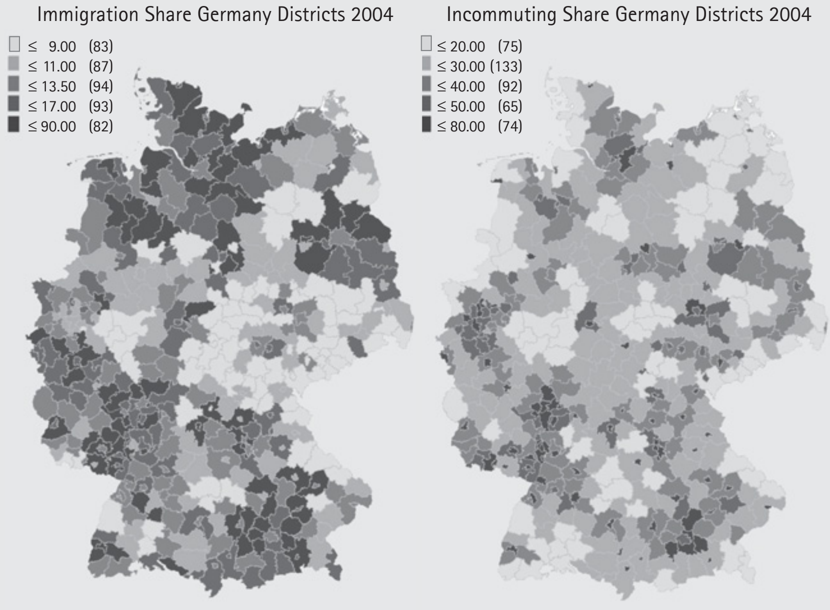


16 Net migration is defined as immigrants into a region minus emigrants from a region. Net commuting is defined as incommuters into a region minus outcommuters from a region. The respective rates are then calculated from the respective net value divided by the employed covered by the social security system ("sozialversicherungspflichtig Beschäftigte") measured at the place of work. All variables are annual values for the year 2004.

The net migration rate (upper figure) shows a range of about –7 percent to 6 percent of all employed at the place of work, whereas the net commuting rate (lower figure) varies between –130 percent to 75 percent. For the net migration rate, most districts in Eastern Germany with high unemployment rates show negative net migration rates, i.e. more emigrants than immigrants. Consequently, the net migration rate shows a clearly negative relationship with the unemployment rate and confirms the findings of the migration literature cited above. The coefficient for the unemployment rate amounts to –0.20 and is significant on the 1 %-level. The R^2 of the estimation is quite high and amounts to 0.44. The regression of the commuting rate on the unemployment rate shows instead a slightly positive influence which is significant on the 5 %-level. This is due to the fact that cities often display high unemployment rates as well as positive net commuter streams. But, as the R^2 of the estimation is almost zero (0.01), we conclude that commuting activities are largely independent of the unemployment rate. Thus, in the case of commuting, urban-rural structures are more likely to dominate the sign of the rate: rural districts often show negative net commuting rates, whereas urban districts have more incommuters than outcommuters.

Up to now, the relationship between migration, commuting and the unemployment rate was investigated by using net values. As net values hide the actual extent of mobility between districts, gross figures are probably still more important. They show the actual extent of the mobility present in the labour market and characterize the adjustment potential of these variables. If e.g. the unemployment rate in a district is 10 percent, but immigration amounts to 20 percent and incommuting even to 50 percent of all employed persons, one can easily imagine that additional workers needed through a positive labour demand shock are likely to come from all sources, i.e. unemployed, immigrants and incommuters. Therefore, gross figures of migration and commuting for Federal States and districts are analysed in the following. As districts are quite small compared to larger regional units like Federal States, already relatively small distances are sufficient to cross a district boarder. Consequently, migration and commuting activities should be much more intense than on a larger regional level. The share of immigrants and incommuters to all employed in a district (place of work) can be seen in Figure 17:

Figure 17: Shares of immigrants and incommuters for districts in 2004



The left map of Figure 17 shows the immigration share with respect to all employed persons per district in 2004. With the exception of Göttingen, where the immigration share amounts to 82 percent,[17] the immigration shares vary between 5 percent and 32 percent. As not all immigrants are at the same time new job owners as they bring their families with them, the share of immigrants who actually fill a vacancy should be lower. But, given the observed magnitude, these figures impressively demonstrate the importance of migration activities at district level. Generally, high immigration shares can be found in districts close to city districts. This development reflects recent suburbanisation trends. In Saxony, Saxony-Anhalt and Thuringia, immigration proportions are low, whereas especially around the capital city of Berlin and around big metropolitan areas like Munich (Bavaria), Frankfurt (Hesse) or Hamburg (City State of Hamburg), immigration shares are high.

The share of incommuters displayed in the right map of Figure 17 even shows much higher values than for immigration. The range of the incommuting share varies between 10 percent and 76 percent of all employed in a district. As commuters are defined as people who live in another district as they work, all

17 Immigraton and Emigration figures in the district of Göttingen amount to 71,803 and 70,920, respectively and thus amount to about 40 percent of the resident population. These figures show an enormous fluctuation and might be due to the large University situated in the district. As the migration effect in the estimations of Section 4.5 is determined as residual value and is therefore neither endogenous nor exogenous, the district remains in the sample and is not excluded.

incommuters are at the same time also employed in their district of destination. This means that up to 3/4 of all employed in a district live outside the district they work. These figures show the potential influence that commuting activities might have on adjustment processes at district level in the aftermath of a labour demand shock. As can be seen from Figure 17, commuting patterns are even more clear cut than for immigration shares: with the exception of Berlin, commuter streams clearly concentrate towards city centres. Regions with low commuting figures are partly the same than those with low immigration rates. Those regions are probably simply not attractive to workers due to a lack of job offers.

To be able to compare the figures for districts to a larger regional level, we calculate different mobility measures for districts as well as for Federal States. The means of these measures over all 439 districts and 16 Federal States (East and West Germany) are displayed in Table 7:

Table 7: Mobility measures for districts and Federal States (average values) in 2004

	Districts	Federal States	Districts/Federal States
Immigration share	13.18	7.75	1.70
Emigration share	12.38	8.03	1.54
Incommuting share	34.21	12.99	2.63
Outcommuting share	38.98	12.35	3.15
Incommuting/Immigration	2.84	1.56	1.82
Outcommuting/Emigration	3.49	1.61	2.17

Immigration and incommuting shares are based on employment at the place of work, emigration and outcommuting shares are based on employment at the place of residence. For each regional level immigration and emigration as well as incommuting and outcommuting shares have approximately the same size. As each movement across a Federal States boarder is also registered as movement between districts, the figures for districts must necessarily be higher. The question that arises is how much. Emigration and immigration are about 1.5 to 1.7 times as large and incommuting and outcommuting ratios are even 2.6 to 3.2 times as large. Another important observation is that for districts as well as for Federal States, the commuting shares are higher than the migration shares. The ratio of commuting to migration is around 3 for districts, meaning that commuting activities are about 3 times as large as migration figures. For Federal States, this ratio still amounts to approximately 1.5.

The main results from this short investigation are the following: The net migration rate shows a clear negative relationship with the unemployment rate. This is an indicator for the neoclassical adjustment theory that migration streams move from high to low unemployment regions. Net commuting rates instead turn out to be largely independent from regional unemployment rates. The spread of both, net migration and net commuting rates across districts are immense, but, the spread of the net commuting rates is more than 10 times larger. Gross migration and commuting activities are also immense for districts as well as for Federal States, but mobility is still much larger for districts. Thus, migration and commuting offer a high potential for the adjustment behaviour of districts as well as for Federal States after adverse labour demand shocks. Consequently, the two different approaches to estimate the model of Blanchard/Katz (1992) discussed at the end of section 4.1 need to be applied for both regional levels.

4.4 Empirical framework and district-specific data

This section introduces the empirical framework proposed by Blanchard/Katz (1992) and shortly characterises the region-specific dataset via the most important statistics. The estimation results and comparisons with other studies on regional adjustment are presented in section 4.5.

In their seminal paper, Blanchard/Katz (1992) have developed a regional model to explain the adjustment mechanism at work after a region is hit by a shock (see section 4.1). Furthermore, in the empirical part of their paper, they use a Vector-Autoregressive (VAR) approach for each single region and do pooled OLS-estimates for groups of regions and the whole US to trace the effects of a labour market demand shock on the regional employment level, the unemployment rate and the participation rate. Blanchard/Katz (1992) use simple differences between the regional and the aggregate variables to obtain region-specific variables. Our data are on a highly disaggregated regional level and show strong differences in the cyclical sensitivity, i.e. regional variables do not necessarily follow the development of their national counterparts. This holds for unemployment rates as well as for other variables like regional employment growth, employment rates or participation rates. As the aim of the estimates is to trace the adjustment of regional variables, variation in the data due to national effects has to be removed. As regions – especially on a small regional level – are different in their sector structure, the extent of the cyclical sensitivity varies substantially. Therefore, the influence of the national on the regional variables is estimated for each regional unit separately according to the cyclical sensitivity model developed by Thirlwall (1966) and Brechling (1967). As outlined already in section 3.2, the equation to estimate for each regional unit and each variable is

$$X_{it} = a_i + b_i X_t + e_{it} \tag{23}$$

where X_{it} and X_t are the regional and the national variable, respectively. Thus the parameter b_i measures, how a variable in region i is affected by variations in its national counterpart. Region-specific variables are then constructed as beta differences, i.e. the regional value minus b_i times the national value. For a general discussion about the construction of regional relative variables see section 3.3. The regional employment growth rate, $\tilde{N}_i$, can be approximated via the relation

$$\tilde{N}_{it} \approx \Delta\, log(N_{it}) = log(N_{it}) - log(N_{it-1}) \tag{24}$$

where N_i is the regional employment level. The regional relative employment growth rate, Δn_i, is then given by

$$\Delta n_{it} = \tilde{N}_{it} - \hat{\alpha}\, \tilde{N}_{Dt} \tag{25}$$

where $\tilde{N}_i$ is defined as in equation (24) and $\tilde{N}_D$ is the national employment growth rate.

For the regional relative employment rate, e_i,

$$e_{it} = log(E_{it}) - \hat{\beta}\, log(E_{Dt}) \tag{26}$$

is used, where E_i and E_D stand for the regional and the national employment rate, calculated as the ratio of employment to the labour force.[18] As $log(E_{it}) \approx -U_{it}$, the regional relative employment rate can also be interpreted as the negative of the regional unemployment rate u_i, given by

$$u_{it} = U_{it} - \hat{\delta}\, U_{Dt} \tag{27}$$

Last, the regional relative participation rate, p_{it}, can be calculated as

$$p_{it} = log(P_{it}) - \hat{\gamma}\, log(P_{Dt}) \tag{28}$$

18 Employment is the number of persons with a job that contributes to the social security system. The labour force is defined as the sum of employed and unemployed persons.

where P_i is the regional participation rate (the regional labour force divided by the working age population) and P_D for the national counterpart.

To give an impression of the national and regional variation in the data, the minimum and maximum values of the regional employment growth rate approximated by log differences $\tilde{N}_i$, the employment rate E_i, the participation rate P_i for districts and the corresponding national values for Germany in 2004 are briefly described. The mean employment growth rate at the place of work for Germany was –1.48 percent. Those values were nearly the same for the employment growth rate measured at the place of residence. The regional variation of $\tilde{N}_i$ at the place of work was instead substantial and reached from –5.32 percent in the district Südwestpfalz (Rhineland-Palatinate) up to 2.82 percent in the city district of Hamm (North-Rhine Westfalia). For the place of residence the employment growth rate also varied substantially although not as strong as for the place of work: the minimum of –3.82 percent was measured in Wilhelmshaven city (Lower-Saxony) and the maximum growth rate amounted to 0.74 percent in the city district Landau in der Pfalz (Rhineland-Palatinate). As the estimates in section 4.5 only use regional employment and participation rates, both measured at the place of residence, here only these variables are described. The national employment rate, defined as employed over labour force,[19] amounted to 88.72 percent. The regional span of the employment rate reached from 75.71 percent in Bremerhaven city (Bremen) to 95.51 percent in Eichstätt (Bavaria). The national mean of the participation rate, defined as labour force over the population aged 15–65 years, amounted to 54.40 percent in the year 2004. Similar to the regional employment rate, the participation rate across districts was found to vary within a span of about 20 percentage points: the lowest value was observed in the city district of Heidelberg (Baden-Württemberg) where only 42.01 percent of the working-age population were actually in the labour force, whereas the same value amounted to 62.40 percent in Coburg city (Bavaria). The region-specific values are then obtained by regressing the national on each regional time series for each variable according to equation (23).

Given these region-specific variables, the empirical framework of Blanchard/Katz (1992) is employed in the following system of equations:

$$\Delta n_{it} = \lambda_{i10} + \lambda_{11}(L)\Delta n_{it-1} + \lambda_{12}(L)e_{it-1} + \lambda_{13}(L)p_{it-1} + \varepsilon_{i\Delta nt} \quad \textbf{(29)}$$

$$e_{it} = \lambda_{i20} + \lambda_{21}(L)\Delta n_{it} + \lambda_{22}(L)e_{it-1} + \lambda_{23}(L)p_{it-1} + \varepsilon_{iet} \quad \textbf{(30)}$$

19 The labour force is always measured at the place of residence.

$$p_{it} = \lambda_{i30} + \lambda_{31}(L)\Delta n_{it} + \lambda_{32}(L)e_{it-1} + \lambda_{33}(L)p_{it-1} + \varepsilon_{ipt} \quad \textbf{(31)}$$

where L is a time-series lag operator and represents lag-polynom λ_{ij}. The variables in the system are defined as in equations (25), (26) and (28) and were tested for stationarity according to common panel unit root tests proposed by Levin/Lin/Chu (2002) and Im/Pesaran/Shin (2003). The null of non-stationarity is rejected on a highly significant level in both tests, i.e. all variables in the system are stationary.[20] To ensure that we indeed capture the effect of a labour demand shock, the regional relative employment growth rate may affect the unemployment rate and the participation rate in the same period but not vice-versa. The effect of an innovation in labour demand is identified by tracing the effects of a shock in the regional relative employment growth rate, $\varepsilon_{i\Delta nt}$.

4.5 Regional adjustment dynamics

In this section, the empirical framework of Blanchard/Katz (1992) is applied to West German Federal States and districts to obtain the adjustment processes of the involved labour market variables. The results are compared with respect to two dimensions: First, the results for Federal States are compared with the smaller regional level of districts. Second, the results for the estimates of shocks in the employment growth rate at the place of residence are compared to those estimated for shocks at the place of work. Before, research results for Germany are discussed in the context of the international adjustment literature according to Table 2.

As the investigation of regional adjustment by Blanchard/Katz (1992) for the US and Decressin/Fatás (1995) for Europe and the US shows, adjustment to region-specific shocks differs between Europe and the US in two major points. First, the long-run effect on a regions employment share is much larger in the US than in Europe (not depicted in Table 2, see Decressin/Fatás (1995)). Second, they find that in the US, labour market shocks are immediately reflected in labour migration, whereas in Europe, the participation rate is the dominant equilibrating mechanism. In Europe, migration accounts only after three years in the aftermath of a shock for a substantial part of the adjustment process. Surprisingly the regional unemployment rate is hardly affected after a region-specific shock in both, Europe and the US. Decressin/Fatás (1995) also provide results for German regions: similar to their results for Europe they find that the

20 IPS and LLC test were conducted for variables on district level only. In both tests, the null of non-stationarity is rejected on the 1 % significance level for all variables. The results can be found in the Appendix.

employment level rises permanently by approximately two third of the initial labour demand shock (not depicted in Table 2, see Decressin/Fatás (1995)). The adjustment process of the employment level has completely settled after about 9 years. As in their results for Europe, the labour force participation rate is the dominant equilibrating mechanism, whereas the unemployment rate and migration do not account for much in the first year after the shock. This can be similarly found in other European countries like Italy, the UK, the Netherlands, Belgium or Finland, see Table 2. In Spain, Sweden and the US instead, migration plays a more important role. A quick adjustment of the unemployment rate can also be found in Finland, Italy, Sweden and the Netherlands, whereas the Spanish and the Belgian unemployment rate recovers only very slowly. Only the Swedish, the Belgian and the Dutch participation rates recovers nearly as quickly as the German one. The Italian and the Spanish one need more than 10 years to reach their initial value. The quick adjustment of both, the unemployment and the participation rate in Germany suggests strong migration flows in the years after the shock. Thus, already in the second year after the shock, the additional workers that are needed to reach the new employment level come completely through migration. A similarly quick adjustment pattern can be only observed for Sweden and the Netherlands.

4.5.1 Estimation results

For the estimation of regional adjustment, the time series cover only nine observations for East German (1996–2004) and 16 for West German districts (1989–2004). Following the studies of Blanchard/Katz (1992), Decressin/Fatás (1995) or Frederiksson (1999), two lags are allowed for each variable.[21] Due to the differentiation and the inclusion of two lags of each variable, three observations are lost. As the estimation period for the series in East Germany thereby decreases to 6 observations (1999–2004), we do not run pooled regressions for the East German part and the unified Germany. Thus, estimation results are provided only for the relatively long period of 1989–2004 for West Germany. The estimates are additionally run for West German Federal States to compare the adjustment of different regional levels. Nickell (1981) shows that a fixed effects estimator in a dynamic panel model is inconsistent for fixed *t*. Pesaran/Smith/Im (1995) suggest a mean-group estimator, i.e. the mean of separate regressions obtained for each group (districts or regions in this case), which yields consistent estimates of the

21 Tests results for the optimal lag length (AIC-/BIC-Criteria) showed that the inclusion of one lag for each variable would be sufficient. In order to allow for non-monotone adjustment paths and to be able to compare our results to the estimations of other authors, we also used two lags for each variable.

average effects as the number of time periods increases to infinity. Frederiksson (1999) argues that the Seemingly Unrelated Regression (SURE) produces similar, but more precise results, as it is more efficient and considers the regional correlation between each variable in the VAR. Therefore, the system of equations above is estimated as SURE-model that additionally has the advantage that it is still comparable to studies using a VAR-model estimated by OLS. As mentioned above, two lags are allowed for each variable. Additionally, a dummy-variable for each district in each equation is added to capture regional fixed effects. As already outlined in sections 4.1 and 4.3, the estimates are carried out for two different scenarios: first, shocks in the employment growth rates observed at the place of residence are traced to measure the effect of a labour demand shock on unemployment, participation and migration. Second, shocks in the employment growth rates observed at the place of work are traced to measure the effect of a labour demand shock on unemployment, participation and labour mobility, defined as migration and commuting activities. The estimates of equations (29)–(31) for both scenarios of Federal States and districts in the period 1989–2004 are listed in Table 8.[22] The first column contains the independent variables of each equation. Δ is a time-series difference operator and the variables are defined as in equations (25), (26) and (28). Columns 2–5 show the estimation results equation by equation for each setting.

Table 8: Estimation coefficients of regional adjustment

	Federal States: Place of		Districts: Place of	
	Residence	Work	Residence	Work
Observations	**130**	**130**	**4,238**	**4,238**
Equation (25)	Dependent Variable: Employment Growth Rate Δn_{it}			
Δn_{it-1}	0.173	0.347***	0.157***	0.130***
Δn_{it-2}	0.350***	0.042	0.153***	0.087***
e_{it-1}	–0.096	–0.145	–0.046*	0.060
e_{it-2}	–0.249*	–0.134	–0.215***	–0.328***
p_{it-1}	–0.184**	0.054	–0.225***	–0.032
p_{it-2}	–0.081	–0.075	–0.047***	–0.116***

22 The values of the region-specific dummies are not presented to save space.

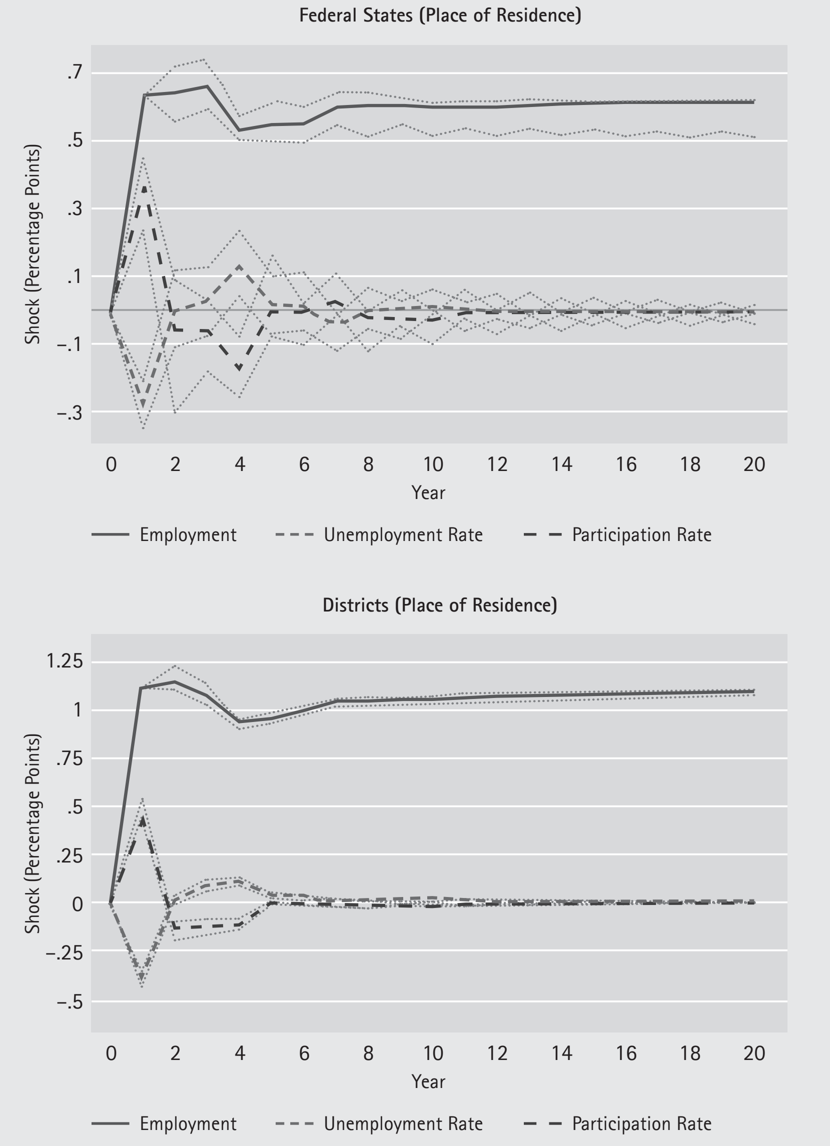
	Federal States: Place of		Districts: Place of	
	Residence	Work	Residence	Work
Observations	130	130	4,238	4,238
Equation (26)	Dependent Variable: Employment Rate e_{it}			
Δn_{it}	0.431***	0.525***	0.354***	0.132***
Δn_{it-1}	–0.055	–0.114	–0.063***	0.004
e_{it-1}	0.961***	0.989***	0.971***	0.932***
e_{it-2}	–0.302***	–0.275***	–0.236***	–0.240***
p_{it-1}	0.067	–0.021	0.099***	0.022**
p_{it-2}	0.061	0.073*	0.015	0.028***
Equation (27)	Dependent Variable: Participation Rate p_{it}			
Δn_{it}	0.561***	0.138	0.449***	0.029***
Δn_{it-1}	0.103	0.102	0.009	0.026**
e_{it-1}	0.097	0.147	0.031	0.060**
e_{it-2}	0.215	0.120	0.094***	–0.012
p_{it-1}	0.559***	0.532***	0.631***	0.569***
p_{it-2}	–0.090	–0.174*	–0.017	–0.056***
*, **, *** significant at the 10, 5 and 1 percent level.				

The aim of the estimates is to compare the dynamics of the system for different regional levels with respect to the magnitude and the length of the adjustment mechanisms. Therefore we trace the effect of a one-standard-deviation shock in the relative employment growth rate. Figure 18 displays the adjustment of relative employment, the unemployment rate[23] and the participation rate after a positive one-standard-deviation-shock to relative employment growth rate (a shock in $\varepsilon_{i\Delta n}$) at the place of residence according to the above estimation results. The corresponding 95 %-confidence intervals are plotted as dotted lines.[24]

23 The results for the unemployment rate are obtained by using the relationship $u_{it} \approx -e_{it}$. By using this relationship, the unemployment rate as well as the participation rate are calculated with the same number of people in the labour force.

24 The 95 %-confidence intervals were generated by bootstrap methods and are based on 1,000 replications of each estimation, see e.g. Efron/Tibshirani (1993).

Figure 18: Adjustment of employment, unemployment and participation to a labour demand shock (Place of Residence)



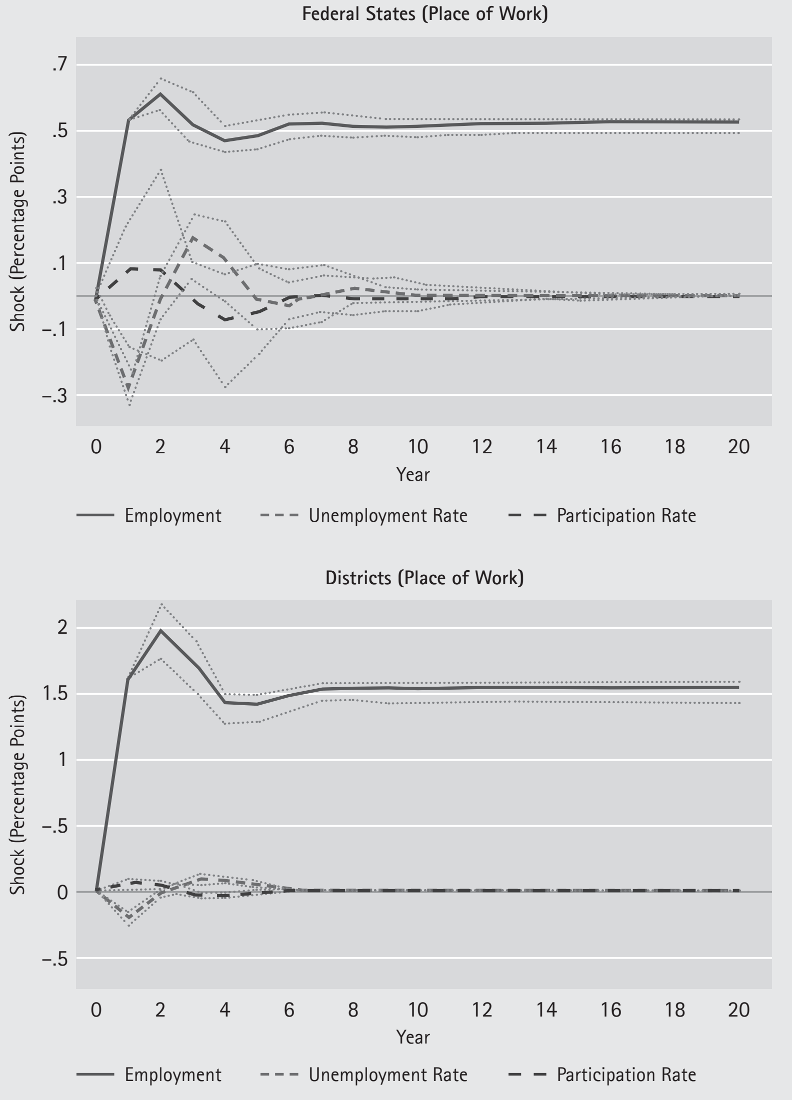
The adjustment process after a shock in labour demand shows that the unemployment as well as the participation rate return fairly quickly to their initial values whereas the employment level is permanently affected. This result holds for both regional levels. For Federal States, a shock of 0.64 percentage points rises the employment level permanently by nearly the same amount (0.62 percentage points). In the initial year, this shock increases the participation rate by 0.36 and decreases the unemployment rate by 0.28 percentage points. In the case of districts, the shock is nearly two times as large as for Federal States (1.11 percentage points) and causes a permanent rise in the employment level of about 1.09 percentage points. Thus, for Federal States as well as for districts, nearly the complete shock remains inside the region. In the first year, the shock increases the participation rate by 0.50 percentage points and causes a decrease of about 0.39 points of the unemployment rate.

Looking at the adjustment process of Federal States (upper figure), the unemployment and the participation rate return to their initial value already in the period after the shock and have completely settled after about four years. The employment level in turn remains permanently on a plateau of about 97 percent of the initial shock which is reached after approximately six years. In the first year, the unemployment rate captures about 43 and the participation rate about 56 percent of the initial shock. According to the model, only the 1 percent left is adjusted by interregional migration (immigration in this case). The return to the initial value in the period after the shock and the "overshooting" of both, the unemployment and the participation rate in the second and third year after the shock in the presence of a relatively stable employment level means instead that these variables must be overcompensated by substantial immigration in the following years.

For West German districts (lower figure) the picture looks quite similar to the one for Federal States: Here, the unemployment rate captures roughly 35 percent of the initial shock and 45 percent of the shock are absorbed by an increase of the participation rate. Thus, as already observed for Federal States, in the year of the shock new jobs are mainly filled through people moving into the labour force or out of unemployment, but immigration accounts only little for regional adjustment. But, different to Federal States, migration still accounts for 20 percent of the shock during the first year. In the years after the shock, the adjustment is again very similar to the one observed already for Federal States, although less pronounced. The conclusion is again that immigration must be extensive in the year after the shock. After about four to five years, the initial shock in relative employment has nearly completely settled in all variables and relative employment remains permanently at about 98 percent of the initial shock.

The adjustment processes for Federal States and districts for a one-standard-deviation shock in the employment growth rate measured at the place of work are displayed in Figure 19.

Figure 19: Adjustment of employment, unemployment and participation to a labour demand shock (Place of Work)



The size of the shocks at the place of work is quite similar to the shocks measured at the place of residence for each regional level. Again, the unemployment as well as the participation rate return fairly quickly to their initial values whereas the employment level is permanently affected. The adjustment processes instead look differently: for Federal States, a shock of 0.54 percentage points rises the employment level permanently by nearly the same amount (0.52 percentage points). In the initial year, this shock increases the participation rate by only 0.07 and decreases the unemployment rate by 0.28 percentage points. In the case of West German districts, the shock is about three times as large as for Federal States (1.62 percentage points) and causes a permanent rise in the employment level of about 1.54 percentage points. In the first year, the shock increases the participation rate by only 0.05 percentage points and causes a decrease of about 0.21 points of the unemployment rate. The adjustment path of the participation rate is not significant for Federal States and displays only a very small positive significant effect for districts. Thus, for both regional levels, the participation rate contributes almost nothing to regional adjustment in the first year.

In the case of Federal States (upper figure), the unemployment rate returns to its initial value already in the period after the shock whereas the participation rate returns in the second period after the shock. The adjustment processes have nearly completely settled after about four to five years for both variables. The employment level in turn remains permanently on a plateau of about 96 percent of the initial shock which is reached after approximately five years. In the first year, the unemployment rate captures about 52 percent and the participation rate about 14 percent of the initial shock. Following the considerations of section 4.1, the remaining 34 percent left must be adjusted by immigration and incommuting. Thus, compared to the estimation for the place of residence, the unemployment rate, migration and commuting activities are responsible for the adjustment of Federal States in the first year. The return to the initial value in the periods after the shock and the overshooting of the unemployment and the participation rate in the second and third year after the shock in the presence of a relatively stable employment level is again characterised by a substantial response of immigration and incommuting.

For West German districts (lower figure), the unemployment rate captures only roughly 13 percent of the initial shock and only a negligible part of the shock (3 %) results in an increase of the participation rate. Thus, in the year of the shock, 84 percent of the new jobs are filled through people migrating or commuting into the district, whereas unemployed persons getting a new job account for only a small share and people moving into the labour force do almost not occur. Compared to Federal States the adjustment share of immigration and incommuting in the year of the shock is nearly 2.5 times as high. In the following years, the adjustment processes of unemployment and participation are also characterised by overshooting, but the extent is negligible. The conclusion is that immigration and incommuting react so quickly that nearly the whole shock is already absorbed in the same year when it occurs. The relative employment level remains permanently at about 95 percent of the initial shock.

The results of the estimates for Germany are summarized in Table 9 according to the structure of Table 2.[25]

Table 9: Results for regional adjustment in Germany

Study		Adjustment			Duration	
Country	Region, time, place of employment	u_i	p_i	m_i	u_i	p_i
Germany (W)	10 Federal States, 1989–2004 (residence)	0.43	0.56	0.01	1	1
Germany (W)	10 Federal States, 1989–2004 (work)	0.52	0.14	0.34	1	2
Germany (W)	326 districts, 1989–2004 (residence)	0.35	0.45	0.20	1	1
Germany (W)	326 districts, 1989–2004 (work)	0.13	0.03	0.84	1	2

Altogether, the results for regional adjustment in Germany presented in Table 9 are in line with other studies in this field. Compared to Decressin/Fatás (1995), who stress the participation rate as dominant equilibrating mechanism in Germany and Europe, our estimates suggest that the unemployment rate also contributes a substantial part. If the estimates additionally allow for commuting, the share of adjustment through labour mobility rises to one third of the initial shock whereas only 14 percent is captured by the participation rate. Similar to Decressin/Fatás (1995), unemployment and participation rates return to their initial values already in the year after the shock. This suggests strong labour mobility in the year after the shock and demonstrates that commuting is an important adjustment mechanism even in the case of larger regional units as Federal States. The results found for districts additionally show that the level of disaggregation is relevant in this context. Smaller regional units principally show stronger adjustment via interregional mobility – independent from the measurement at the place of work or residence. The unemployment rate still accounts for a significant share but adjustment via the participation rate is almost negligible if employment is measured at the place of work. These results are not surprisingly as smaller regional units should adjust to a higher degree via interregional mobility but were not shown in regional economics to our knowledge until now.

The main results of this section are the following: First, smaller regional units as districts adjust differently than larger regional units, e.g. Federal States. In both estimates – labour demand shocks at the place of residence and at the place of

25 To avoid the effects of relatively small (City) Federal States, we also run our estimations for the same seven regions as in Decressin/Fatás (1995), where the City States Bremen and Hamburg and the relatively small State Saarland were aggregated to larger neighbouring Federal States to obtain more homogenous regions. The results were similar to the estimations for Federal States. Only the migration share in the year of the shock is a little more pronounced.

work – interregional mobility accounts for a significantly larger proportion of the adjustment process in the case of districts than on a larger regional level. Unemployment and participation in turn account for lower shares. Second, migration and commuting activities turn out to play an important role for regional adjustment. This observation is especially important and very distinct for districts but holds as well for Federal States. Third, the duration until the initial values of the unemployment and the participation rate are reached again is only about one to two years. Thus, slow working adjustment mechanisms in the aftermath of labour demand shocks are not responsible for persistent unemployment differentials as described in section 4.

4.6 Conclusions of simultaneous models

The paper shows that migration and commuting activities are distinct for districts as well as for Federal States, but several mobility measures are larger for districts. Regressions of the net migration and the net commuting rate on the regional unemployment rate show a clear negative relationship of net migration and unemployment, whereas net commuting turns out to be largely independent from regional unemployment. This demonstrates that migration streams move from high to low unemployment regions. Commuter streams are instead mainly driven by urban-rural patterns and can rather be interpreted as labour movement across districts to even out sharp structural differences.

The results for the different mechanisms of labour market adjustment according to the model of Blanchard/Katz (1992) obtained for Federal States and districts are in line with other studies in this field. Estimates of shocks to labour demand at the place of residence suggest that adjustment to region-specific shocks in the first year is mainly through participation behaviour and unemployment changes, not by migration. But, as unemployment and participation rates return to their initial values already in the year after the shock, this suggests strong migration flows in the year after the shock. These results hold for Federal States as well as for districts. If, however, the estimates additionally allow for commuting as adjustment mechanism, the picture changes considerably: compared to the estimation at the place of residence, the unemployment rate and interregional mobility (i.e. migration and commuting activities) capture the major part of adjustment during the year of the shock. The participation rate in turn accounts for only a very small share. Thus, migration and commuting are highly relevant for the adjustment behaviour of districts as well as for Federal States. Again, the duration until the unemployment and the participation rate return to their initial values is only about one to two years. As this fast adjustment holds for all different estimates, slow working adjustment mechanisms in the aftermath of labour demand shocks are not responsible for persistent unemployment differentials as described in section 4.

Furthermore, the adjustment processes of districts and Federal States differ substantially with respect to the degree of openness: in both estimates – labour demand shocks at the place of residence and at the place of work – interregional mobility accounts for a significantly larger proportion of the adjustment process in the case of districts than on a larger regional level. Unemployment and participation rates in turn account for lower shares. Thus, the hypothesis that the adjustment process for smaller spatial units is much more reflected in interregional migration or commuting and less in changes in the unemployment and the participation rate, is confirmed.

5 Sources for regional unemployment disparities in Germany – a hybrid model

The development of the national as well as the regional labour market is influenced by a variety of factors more or less closely related to the typical outcome variables like employment or unemployment figures. Moreover, these variables interact with each other in the same period or – more probably – with a specific time lag. Thus, observed reactions in the labour market at present are caused by different variables at different points of time. Especially for a regional economy, things become even more complex: it can be treated as small open economy reacting on shocks within the region but also on exogenous changes of the economic situation, e.g. in the national economy. Therefore, a region is likely to respond to both, regional as well as national shocks.

One of the most important labour market outcome variables is the unemployment rate. In many European countries and as well in Germany, the range of the regional unemployment rates within the country is enormous and even greater than between countries. As already seen in section 3.4.1, the unemployment rate at district level in Germany in June 2011 had a range between 1.2 and 17.3 percent. Additionally, these disparities maintain over long periods of time, see section 3.4.2. Therefore, another important question aims at the possible sources of these persistent disparities. Most of the common regional labour market literature considers only two alternative explanations for the existence of regional unemployment differentials: equilibrium approaches interpret the interplay of labour market (related) variables as long-run relationship, where regional unemployment rates are determined by a set of regional explanatory variables. Usually, this long-run equilibrium is thought of as natural rate of unemployment (NAIRU) where shocks lead to a fluctuation around this equilibrium but adjustment mechanisms force the unemployment rate back to its natural rate of unemployment. Hysteresis models instead consider each shock in the labour market as permanent, i.e. each shock directly changes the unemployment rate – a natural rate does not exist.

A number of approaches try to bridge the gap between equilibrium and hysteresis approaches by assuming that unemployment depends on its lagged values but tends towards a natural rate in the long-run. The Blanchard/Katz (1992) model outlined above is one of the most elaborate attempts to fill this gap as it not modeled in a single equation but in a system approach. It belongs to the equilibrium-model class and concentrates on the explanation of labour market relationships where the unemployment rate itself is not explicitly modeled as dependent variable. The unemployment rate is instead calculated from the estimated relationships. Elhorst (2003) therefore refers the Blanchard/Katz (1992) model as implicit model – a sub class of the equilibrium models. The advantage of a system approach is that the interplay of lagged adjustment processes is explicitly modeled in the system of labour market equations. Changes in the endogenous variables – commonly modeled as shocks in labour demand – implicitly influence the unemployment rate and adjustment mechanisms force the labour market back towards its equilibrium. If the shocks have settled, regions may exhibit different equilibrium unemployment rates with specific exogenous shift-effects of labour demand or labour supply as forcing terms.

The chain reaction theory of unemployment (CRT) developed by Karanassou/ Snower (2000) is another implicit model that employs a simultaneous labour market system approach. The system consists of a labour demand, a labour supply and a wage-setting equation and unemployment can be calculated as difference between labour supply and labour demand. In contrast to the standard Blanchark/ Katz (1992) model it explicitly suggests exogenous variables as the capital stock or the working age population to influence the endogenous variables. The central idea of the CRT is twofold: first, the labour market is not only characterized by lagged responses to past labour market activities but theses lagged responses interact with on another and affect unemployment. Second, the resulting network of lagged labour market adjustment processes interacts with the dynamic structure of labour market shocks. Therefore, it distinguishes between permanent effects, i.e. changes in the long-run relationship on the unemployment rate and persistent effects, i.e. temporal changes in the unemployment rate due to the interplay of lagged adjustment processes. It explicitly considers, first, national as well as regional and second, contemporary as well as lagged values of endogenous and exogenous variables. As the CRT applies a system approach it has clear advantages compared to a single-equation model used in most equilibrium based studies, see Elhorst (2003) for further discussion. The major advantage of the CRT is that it allows to distinguish between equilibrium and hysteresis effects as it enables the researcher to measure the quantities to which the variation of the regional unemployment rate is driven by the change of exogenous variables on the one hand and persistent adjustment behaviour on the other hand. Of course, variations may also be due to both effects, which is also captured by the CRT.

The aim of this paper is therefore to gain a detailed view on the different mechanisms affecting the unemployment rate. Especially, the following crucial questions can be addressed by the CRT: Is it the steady variation of variables or slow working adjustment that leads to stable unemployment differentials observed in Germany at district level? Are adjustment mechanisms present in the labour market? If there are any, how long is the adjustment period of regional unemployment rates after the occurrence of a labour demand shock? Which variables have the strongest influence on the unemployment rate? How much contributed regional and national exogenous factors to the development of the unemployment rate during the observation period? Do high, middle and low unemployment regions react similarly or do they show differences in the adjustment paths and in the reaction to exogenous shocks? These questions are answered in the empirical part or the paper.

The rest of section 5 is organized as follows: In section 5.1 the theoretical background of the chain reaction theory is presented. In section 5.2 follows a brief description of the dataset used in this paper. Section 5.3 empirically investigates stationarity of the variables at district level in Germany. The potential sources of unemployment variations, i.e. the persistence of shocks and the effects of exogenous variables are the focus of section 5. Finally, section 5.5 gives some concluding remarks.

5.1 The chain reaction theory of unemployment

As the CRT combines important features of equilibrium and hysteresis approaches it accounts for possible shifts in the levels of variables over time and their lagged adjustment processes. Furthermore the total variation of the different variables can be decomposed into the share of variation due to equilibrium explanations and variation due to hysteresis phenomena. Both shares can be explicitly calculated as the CRT interprets changes in the variables by the concept of "chain reactions": A single shock in one variable leads to changes in all other (endogenous) variables. Various feedback effects captured by the coefficients of lagged variables then determine how strong the effects are felt in the system, how fast the variables return to their steady state and how much of the shock remains in the system. In the following part, the theoretical concept of the CRT developed by Karanassou/ Snower (2000) is briefly described.

As in many studies, the labour market model in the CRT consists of three equations – labour demand, labour supply and a wage setting mechanism. The aggregate labour demand equation is derived from a monopolistic competition approach, where identical firms with monopoly power in the market are confronted with the same production function and product demand of their product. Product supply is modelled as Cobb-Douglas function and depends positively on employment and the capital stock of the firm. The product demand of each firm is calculated as total product demand over the number of firms in the market, weighted with the price level of firm i relative to the price level in the market. The relative price level itself is exponentially weighted with a negative price elasticity of product demand. As a firm sets its employment at the profit maximizing level, its labour demand function can be derived by setting the marginal revenue, i.e. the profit of an extra unit of its output equal to the marginal cost for this unit of output. The marginal revenue of a firm, MR_{it}, is equal to

$$MR_{it} = p_{it}\left(1-\frac{1}{\eta}\right) \tag{32}$$

where p_{it} is the price charged by firm i and η is the price elasticity of product demand. Let the marginal cost, MC_{it}, be

$$MC_{it} = w_{it}\left(\frac{\partial e_{it}}{\partial q_{it}}\right)\xi_{it} \tag{33}$$

where w_{it} is the wage paid by the firm, e_{it} is the number of employed in the firm, q_{it} is the firms output and ξ_{it} is an employment adjustment parameter. Thus, the marginal costs represent the amount of money that is needed to produce an additional unit of output. This amount is ξ_{it} times as large as the usual wage paid by the firm as new employees have to be hired and trained on the job. In more detail, the employment adjustment parameter ξ_{it} equals

$$\xi_{it} = (e_{it}/\sigma e_{it-1})^{\delta} \tag{34}$$

where δ is a positive constant and σ is the "survival rate", i.e. the share of employed staying in the firm. The survival rate is assumed to be sufficiently low so that $e_{it} > \sigma e_{it-1}$. The employment adjustment parameter can therefore be interpreted as training costs of new hires, h_{it}. As the training of new employees is done by incumbent employees (σe_{it-1}) in that period, the training costs equal

$$e_{it}/\sigma e_{it-1} = 1 + (h_{it}/\sigma e_{it-1}) \tag{35}$$

Thus, the greater the ratio of new hires to incumbent employees, the greater the average training cost per employee. If $\delta = 0$, the employment adjustment parameter $\xi_{it} = 1$ and adjustment costs equal zero. If $\delta > 0$, the employment adjustment parameter $\xi_{it} > 1$ resulting in positive adjustment costs.

Given these employment adjustment costs, the marginal product of the product function of a firm is given as

$$\frac{\partial q_{it}}{\partial e_{it}} = \alpha A e_{it}^{-(1-\alpha)}\, k_{it}^{\beta} \tag{36}$$

and the marginal cost, MC_{it}, then equals

$$MC_{it} = \frac{w_{it}}{\alpha A} e_{it}^{1-\alpha} k_{it}^{-\beta} \zeta_{it} \quad \textbf{(37)}$$

Labour demand is then derived by setting the marginal revenue (equation 32) equal to the marginal cost (equation 33) of each firm:

$$\frac{w_{it}}{\alpha A} e_{it}^{1-\alpha} k_{it}^{-\beta} \left(\frac{e_{it}}{\sigma e_{it-1}} \right)^{\delta} = p_{it} \left(1 - \frac{1}{\eta} \right) \quad \textbf{(38)}$$

In the labour market equilibrium $p_{it} = p_t$ and $w_{it} = w_t$. The resulting aggregate labour demand equation if employment E_t and the capital stock K_t are log-transformed and an error term ε_t is added to account for technological shocks then equals[26]

$$E_t = \alpha + \alpha_E E_{t-1} + \alpha_w w_t + \alpha_K K_t + \varepsilon_t \quad \textbf{(39)}$$

where E_t represents labor demand, w_t the real wage and K_t the capital stock at time t.

The wage equation is generated from the reservation wage of each worker in the population, where the wage is equal to the reservaration wage of the marginal empoyee. The reservation wage is different for each worker. Then, if aggregate employment rises, the reservation wage of the marginal employee rises as well. This relation is assumed to be linear and equals

$$w_t = \beta + \beta_E E_t \quad \textbf{(40)}$$

Last, the aggregate labour supply is derived by the labour force participation decision of each person in the working-age: a person will take up work if the marginal return from being in the labour force at least equals the marginal cost of beeing in the labour force. The marginal return is positively related to the employment probability and the wage and negatively to the inactivity rate, i.e. all persons from the working-age-population who are currently not in the labour force. The marginal cost depends positively on the ratio of new entrants into the labour market to incumbent members. Setting the marginal return equal to the marginal cost, the labour force participation equation becomes:

$$L_t = \gamma + \gamma_L L_{t-1} + \gamma_w w_t + \gamma_E E_t + \gamma_Z Z_t \quad \textbf{(41)}$$

with L_t as labor supply and Z_t as working age population at time t.

26 The coefficients a, a_E, a_w, a_K in equation (39) represent functions of the parameters in equation (38).

Equations (39)–(41) describe the labour market in the CRT. As all variables are in logs, the unemployment rate u_t can easily be calculated out of the relationship

$$u_t = L_t - E_t \tag{42}$$

In section 5.4, a more elaborate version of the model presented in equations (39)–(42) is specified. The empirical model is estimated as vector autoregressive (VAR) model with additional exogenous variables of the form

$$A_0 y_{it} = A_1 y_{it-1} + A_2 y_{it-2} + B_0 x_{it} + B_1 x_{it-1} + C_0 z_t + C_1 z_{t-1} + \varepsilon_{it} \tag{43}$$

where u_t is a vector of regional endogenous variables, x_{it} a vector of regional exogenous variables and z_t is a vector of national exogenous variables. A_0, A_1, A_2, B_0, B_1, C_0 and C_1 are the corresponding coefficient matrices for the contemporaneous and lagged endogenous and exogenous variables and ε_{it} is a vector of identically independently distributed (iid) error terms. In contrast to the regional model of Blanchard/Katz (1992), who focus exclusively on regional shocks, the above labour market system considers regional as well as national variables. Therefore, this framework allows to differentiate between the effects of national and regional variation in the data. Different to e.g. Decressin/Fatás (1995) or our approach in section 4, one can then directly use the national and regional values for the estimation. The advantage is that construction and measurement of region-specific (relative) variables is not necessary. As – according to Martin (1997) – the results may seriously depend on how these relative variables are measured, misleading conclusions due to measurement issues are eliminated. Furthermore one is able to discriminate between regional and national effects. Moreover, the framework allows to calculate the extent of changes in the unemployment rate that is due to national and regional variation and enables to show which of the two has a stronger influence on the unemployment rate.

The next section describes the dataset and explains why different combinations of regional units as well as different lengths of the time series are necessary for the estimates in sections 5.3 and 5.4.

5.2 National and regional data

The data set used in this section is provided by the German Federal Employment Agency, the German Statistical Office and the International Monetary Fund. Variables obtained from the Federal Employment Agency are employment and unemployment figures as well as wages. Data from the German Statistical Office contain population data, figures on the gross domestic product (gdp), gross investment figures, the consumer price index, the manufacturer's price index for oil and the gdp-deflator. Oil prices, interest rates and the growth rate of the public consumption expenditures were obtained from the International Monetary Fund. All series are on an annual basis. Table 10 gives an overview of the regional and national variables used for the estimation of the empirical model outlined in section 5.1:

Table 10: Regional and National variables in the dataset

Regional variables			National variables		
n_{it}	Employment	1987–2004	oil_t	Real oil prices	1976–2004
l_{it}	Labour force	1987–2004	inv_t	Real investment	1970–2004
u_{it}	Unemployment rate	1987–2004	int_t	Real interest rate	1991–2004
pop_{it}	Population	1985–2004	$cons_t$	Real public consumption	1992–2004
w_{it}	Real wage	1992–2004			
gdp_{it}	Real gdp	1991–2004			
$Prod_{it}$	Real productivity	1991–2004			

All variables except the unemployment rate u_{it}, the interest rate int_t and the growth rate of public consumption expenditures $cons_t$ are in logs.
Employment, wages, gdp and productivity are measured at the place of work, all other variables are measured at the place of residence, see section 5.4.1 for further discussion.

The employment level contains only people covered by the social securitiy system ("sozialversicherungspflichtig Beschäftigte"). The labour force is calculated as sum of employed and unemployed persons. The unemployment rate is calculated as difference between the labour force and employment. For the population variable only the labour market relevant population in an age of 15–64 years are considered. Wages stem from a two percent random sample of all employed covered by the social security system (IABS). Productivity is calculated as gdp per employed. As the active units in the labour market focus on real rather than nominal values, all nominal variables are deflated by a corresponding price index. The nominal oil prices were deflated with the manufacturer's price index for oil. Wages were deflated with the consumer price index. Gdp, productivity and investment were deflated via the gdp-deflator.

The national and regional variables have different lengths which can be seen in Table 10. This raises the question, which estimates should be carried out with which variables in the following sections. For the tests on stationarity in section 5.3, always the maximum length of the time series is used. In the estimates in section 5.4, only data from 1992–2004 are included as real public consumption limits the data set.

5.3 Stationarity of national and regional variables

For the stability of the labour market system outlined in section 5.1 it is necessary that all variables are stationary, i.e. all lagged coefficients lie outside the unit circle. Therefore, the national and regional variables have to be tested for stationarity. The standard procedures to test times series for stationarity are the Augmented-Dickey-Fuller-Test (ADF) or the Phillips-Perron-Test to mention only the most important. A disadvantage of all these tests is that they have only low power. Therefore, panel unit root tests have been developed to improve the power of the tests. In the recent years, a growing body of literature has developed a variety of approaches. For an overview see Breitung/Pesaran (2006). In the following, we test all variables introduced in section 5.2 for stationarity. For national variables (ordinary time-series data) we use the ADF test and for regional variables (panel data) we employ the two common first generation panel unit root tests of Levin/Lin/Chu (2002) and Im/Pesaran/Shin (2003).

We start with the nationwide variables and use the ADF test allowing for a maximum of two lags in the testing structure. The equation to estimate for each national variable is

$$\Delta y_t = \mu_t + \rho y_{t-1} + \sum_{k=1}^{K} \phi_k \Delta y_{t-k} + \varepsilon_t \qquad \textbf{(44)}$$

where μ_t is a constant term and the lagged differences of y_t, Δy_{t-k}, control for serial correlation among the ε_t. The null hypothesis of the test is that the variable under consideration follows a non stationary process. Each variable is tested including a maximum of two lagged differences, i.e. $K = 2$. The p-value of the test for each variable is shown in Table 11:

Table 11: ADF test for stationarity of national variables

Test	Lags	oil_t	Δoil_t	inv_t	int_t	Δint_t	$cons_t$
ADF	0	0.595	0.000***	0.000***	0.409	0.010***	0.000***
ADF	1	0.570	0.002***	0.009***	0.531	0.006***	0.988
ADF	2	0.658	0.044**	0.000***	0.852	0.141	0.985
*, **, *** significant at the 10, 5 and 1 percent level.							

As can be seen from the estimates, only investment and the growth rate of public consumption expenditures can be considered as stationary whereas the real oil price and the interest rate follow a non stationary process. Therefore, the latter two variables were also tested in first differences. The transformed variables (Δoil_t and Δint_t) are then found to be stationary.

As mentioned already above, panel unit root tests are applied for regional variables. Here, the common first generation tests of Levin/Lin/Chu (2002) and Im/Pesaran/Shin (2003) are used. The basic regression used in both tests (LLC and IPS), is

$$\Delta y_{it} = \rho_i \, y_{i,\,t-1} + \sum_{k=1}^{K} \phi_{ik} \Delta y_{i,t-k} + z'_{it}\gamma_i + \varepsilon_{it} \tag{45}$$

As in the ADF test, the lagged differences of y_{it}, $\Delta y_{i,\,t-k}$, control for serial correlation among the ε_{it}. Furthermore, z'_{it} may be empty or include a constant term, fixed effects or a time trend into the regression. Also the null hypothesis, that $\rho_i = 0$ for all i, i.e. all time series are independent random walks, is the same in the LLC and the IPS test. Thus, both tests use the same basic regression and the same null hypothesis. They differ only in the underlying alternative hypothesis specification. LLC specify a homogenous alternative, where all ρ_i are equal and significantly lower than 0, i.e. all time series are stationary, whereas IPS tests the less restrictive heterogenous alternative, where ρ_i may differ across regions and only a significant fraction of all time series is stationary. The results of both tests can be found in Table 12:

Table 12: IPS and LLC test for stationarity of regional variables

Test	Lags	n_{it}	Δn_{it}	l_{it}	Δl_{it}	w_{it}	Δw_{it}
IPS	0	1.000	0.000***	1.000	0.000***	1.000	0.000***
IPS	1	1.000	0.000***	1.000	0.000***	1.000	0.000***
IPS	2	1.000	0.000***	1.000	0.000***	1.000	0.000***
LLC	0	0.000***	0.000***	0.000***	0.000***	1.000	0.000***
LLC	1	0.000***	0.000***	0.000***	0.000***	1.000	0.000***
LLC	2	0.000***	0.000***	0.000***	0.000***	0.998	0.000***
Test	**Lags**	pop_{it}	Δpop_{it}	$urate_{it}$	gdp_{it}	$prod_{it}$	
IPS	0	1.000	0.000***	0.245	0.320	0.014**	
IPS	1	1.000	0.000***	0.218	0.260	0.011**	
IPS	2	1.000	0.000***	0.009***	0.004***	0.000***	
LLC	0	0.004***	0.000***	0.000***	0.000***	0.000***	
LLC	1	0.001***	0.000***	0.000***	0.000***	0.000***	
LLC	2	0.000***	0.000***	0.000***	0.000***	0.000***	

*, **, *** significant at the 10, 5 and 1 percent level.

The LLC test clearly rejects the null of non-stationarity for all variables except real wages. According to the results of the IPS test only the unemployment rate, gdp and productivity can be considered as stationary whereas regional employment, the labour force, real wages and population series are non-stationary. Again, the first differences of these variables turn out to be stationary in both tests.

Thus, most of the national and regional variables are either integrated of order 1 or defined as relative values or growth rates. To avoid a mixture of level and growth variables in the estimates of section 5.4, only the differences of level variables (i.e. approximately their growth rates, which are all stationary) and relative variables that display stationarity are included in the estimation.

5.4 Results

In this section the estimation procedure and the main results of the labour market model outlined in section 5.1 are presented. Subsection 5.4.1 discusses the econometric specification and the results of the estimates. The following subsection then introduces the measure of unemployment persistence, provides results for strength and speed of the unemployment adjustment process in the aftermath a of a labour demand shock and quantifies the effects of the employment variations during the sample period. Last, subsection 5.4.3 deals with the effects of national and regional exogenous variables on the unemployment rate.

5.4.1 Econometric specification and estimation results

The time series in Table 10 cover 13 observations for West German districts (1992–2004). As in other studies on regional adjustment, two lags are allowed for each endogenous variable to capture non-monotone adjustment paths (see Blanchard/Katz (1992), Decressin/Fatás (1995), Frederiksson (1999)). Due to the differentiation in order of non-stationary variables and the inclusion of two lags of each endogenous variable, three observations are lost. The specification of the model is based on the following theoretical considerations:

Different to Karanassou/Snower (2000) or Bande/Karanassou (2007), who estimate the CRT on national/provincial level, our estimates are carried out for a much smaller regional level (districts). Here, migration and commuting activities display significantly higher values than on a larger regional level, see section 4. As our focus is to simulate effects of labour demand shocks, e.g. the closure of a major employer, we use the employment level at the place of work. The consequence is that the unemployment rate can no more be approximated by log-differences of labour supply and labour demand as labour supply is measured at the place of residence and labour demand is measured at the place of work. Therefore, the unemployment rate is also determined within the model. Because of the close relationship of the unemployment rate on the on hand and labour demand and labour supply on the other hand, we only use simultaneous and one-period lagged labour demand (at the place of work) and labour supply (at the place of residence) development to determine the unemployment rate, but not wages or other exogenous variables.

Furthermore, we only allow labour demand to affect all other variables simultaneously to make sure that we indeed capture labour demand shocks. Labour supply instead does not affect labour demand and wages, but the unemployment rate. Wages are allowed to affect both, labour supply and labour demand, but not the unemployment rate.

For exogenous variables, simultaneous and one-period lagged values are allowed. Real oil prices, gdp and investment figures influence labour demand. Real wages are affected by real productivity, investment and the interest rate and labour demand is influenced by population effects, public consumption behaviour and the interest rate. Additionally, dummy-variables for each district are added in each equation to capture region-specific fixed effects. The selection of the model specification is based on the AIC- and BIC-information criteria.

With regard to the estimation technique, a fixed effects estimator in a dynamic panel model as described above is inconsistent for fixed *t*, see Nickell (1981) or Kiviet (1995 and 1999). Pesaran/Smith/Im (1995) suggest a mean-group estimator, i.e. the mean of separate regressions obtained for each group (districts or regions in this case), which yields consistent estimates of the average effects as the number of time periods increases to infinity. Frederiksson (1999) argues that the Seemingly Unrelated Regression (SURE) produces similar, but more precise results, as it is more efficient and considers the regional correlation between each variable in the VAR. Therefore, the system of equations above is estimated as SURE-model that additionally has the advantage that it is still comparable to studies using a VAR-model estimated by OLS. The system of equations outlined in section 5.1 is estimated by the following econometric specification:

$$A_0\, y_{it} = A_1 y_{i,\,t-1} + A_2\, y_{i,\,t-2} + B_0\, x_{it} + B_1 x_{i,\,t-1} + C_0\, z_{it} + C_1 z_{i,\,t-1} + e_{it} \qquad \mathbf{(46)}$$

$$e_{it} = \mu_i + \upsilon_{it} \qquad \mathbf{(47)}$$

with $i = 1, \ldots, N$ and $t = 1, \ldots, T$. The vectors y_{it}, x_{it} and z_t as well as the coefficient matrices A, B and C are defined as in equation (43). The vector e_i represents the error term and follows a one-way error component model where μ_i captures the regional fixed effect and υ_{it} is identically and independently distributed and not serially correlated.

The estimation results of equation (46) are reported in Table 13:[27]

Table 13: Estimation Results for all districts

Labour demand: Δn_{it}		Wage setting: Δw_{it}		Labour supply: Δl_{it}		Unemployment rate: $urate_{it}$	
Var.	Coeff.	Var.	Coeff.	Var.	Coeff.	Var.	Coeff.
$L\Delta n_{it}$	0.140^{***}	Δn_{it}	-0.116^{***}	Δn_{it}	0.066^{***}	Δn_{it}	-0.193^{***}
$L2\Delta n_{it}$	0.117^{***}	$L\Delta w_{it}$	-0.489^{***}	$L\Delta n_{it}$	0.083^{***}	$L\Delta n_{it}$	-0.174^{***}
Δw_{it}	-0.230^{***}	$urate_t$	0.403^{***}	Δw_{it}	-0.050^{***}	Δl_{it}	-0.348^{***}
$L\Delta w_{it}$	-0.297^{***}	$Lurate_t$	-0.474^{***}	$L\Delta w_{it}$	-0.069^{***}	$L\Delta l_{it}$	-0.097^{***}
Δgdp_{it}	0.113^{***}	$\Delta prod_t$	0.020^{**}	$L\Delta l_{it}$	-0.140^{***}		
$L\Delta gdp_{it}$	0.072^{***}	$L\Delta prod_t$	0.032^{***}	$L2\Delta l_{it}$	0.139^{***}		
Δoil_t	0.006^{***}	Δint_t	0.915^{***}	Δpop_{it}	0.170^{***}		
$L\Delta oil_t$	-0.009^{***}	$L\Delta int_t$	0.480^{***}	$L\Delta pop_{it}$	0.294^{***}		
Δinv_t	-0.028^{**}	Δinv_t	0.195^{***}	Δint_t	0.693^{***}		
$L\Delta inv_t$	0.206^{***}	$L\Delta inv_t$	-0.055^{***}	$L\Delta int_t$	0.095^{***}		
				$cons_t$	0.251^{***}		
				$Lcons_t$	0.269^{***}		
Obs.	3,260	Obs.	3,260	Obs.	3,260	Obs.	3,260
R^2	0.498	R^2	0.355	R^2	0.636	R^2	0.992
-val.	0.000^{***}	p-val.	0.000^{***}	p-val.	0.000^{***}	p-val.	0.000^{***}
*, **, *** significant at the 10, 5 and 1 percent level.							

Each equation is estimated with 3,260 observations. As can be seen from the R^2 of the equations, the fit of the model is high. The estimates again show the complexity of the labour market structure and the signs of the variables are prevailingly compatible to the expectations:

Labour demand (the employment growth rate) depends negatively on the growth rate of real wages. Higher wages thereby reflect higher costs for enterprises and lead to a decrease in the demand of human labour. The gdp growth rate shows a positive impact on the employment growth rate for both, the simultaneous and the lagged observation period. Rising gdp represents the general economic situation: in boom periods with economic growth employment is positively affected – even in the following year. Rising oil prices lead to an increase in the costs for enterprises and have a negative impact on labour demand if both, the contemporaneous and

27 The values for the region-specific effects are not presented.

the lagged coefficient are considered. The demand for labour should go along with rising investment figures as the additional capital stock also affords additional workers. In the estimation, these expectations are confirmed as the growth rate of investment influences labour demand strongly positive if the sum of both, the contemporaneous and the lagged period are considered.

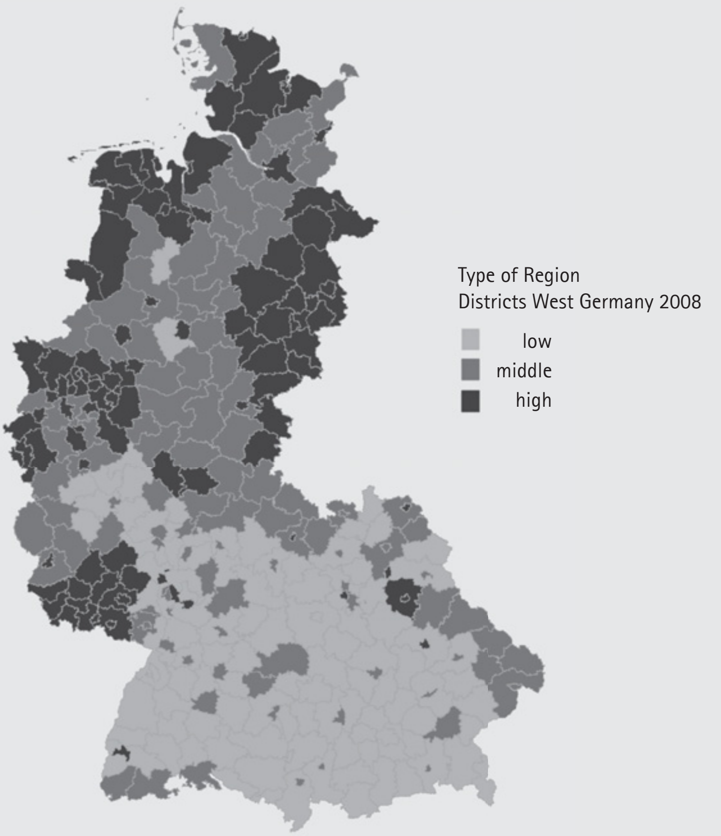
The growth rate of real wages is negatively related to the contemporaneous employment growth rate. This is contra intuitive as a rising employment growth rate should signify a strong labour market where workers are able to push through higher wage claims. In sum, the unemployment rate shows a slightly negative influence on the growth rate of real wages. This negative relationship of the unemployment rate on the (nominal) wage growth rate is known as Phillips curve introduced by Phillips (1958) and can be stated for West German district data. According to the estimates, the interest rate is positively related with the wage growth rate. This is compatible with the expectations as the interest rate usually parallels the economic cycle and should therefore be positively correlated with wages. Real productivity displays a positive influence on real wages for both, the contemporaneous as well as the lagged period, i.e. real productivity growth increases wage growth. This positive effect is in line with the expectations as wages are the monetary outcome of productivity. New investments usually afford higher skills among the workers which then go along with rising wages. This positive effect is stated in the sum of the contemporaneous and the lagged coefficient.

The regional labour force is negatively driven by the regional wage growth rate. This is in contrast to the expectations as rising wages should make more people out of the labour force willing to work. All other variables (employment growth rate, population growth rate, the growth rate of the nationwide public consumption expenditures, changes in the interest rate) show positive signs. The positive effect of the employment growth rate implies that new jobs in a region also increase the regional labour supply. Rising population is a natural source for a rising labour force itself. The positive coefficient of the public consumption expenditure growth rate might reflect labour market programs subsidized by the public hand pushing additional people into the labour force. Rising interest rates causes people to work more because they can expect higher capital returns if they save their wages. Additionally, if people are indepted, they have to work more to be able to pay their rising interest payments. Thus, both explanations justify the observed positive coefficient.

The unemployment rate is negatively affected by both, the growth rate of labour supply and labour demand in the contemporaneous and the lagged period. While a positive employment growth rate means rising employment and therefore directly affects the unemployment rate negatively, the negative sign for the coefficients of the growth rate of labour supply is in contrast to the expectations. The negative sign probably results from migration trends of high skilled labour towards economically prosperous districts with low unemployment rates and thus reflects the well-known effect of selective out-migration.

As an important aim of the paper is to analyse regional disparities in the unemployment rate and the mechanisms at work that generate them, we additionally grouped the 326 districts into 3 equally sized categories with respect to the unemployment rate in 1992: low, middle and high unemployment regions. Low unemployment regions are districts with an unemployment rate below 5.19 percent (109 districts), middle unemployment regions had an unemployment rate between 5.19 percent and 7.50 percent (109 districts) and high unemployment regions are districts with an unemployment rate higher than 7.50 percent (108 districts). The spatial distribution of low, middle and high unemployment regions in 1992 can be seen in Figure 20:

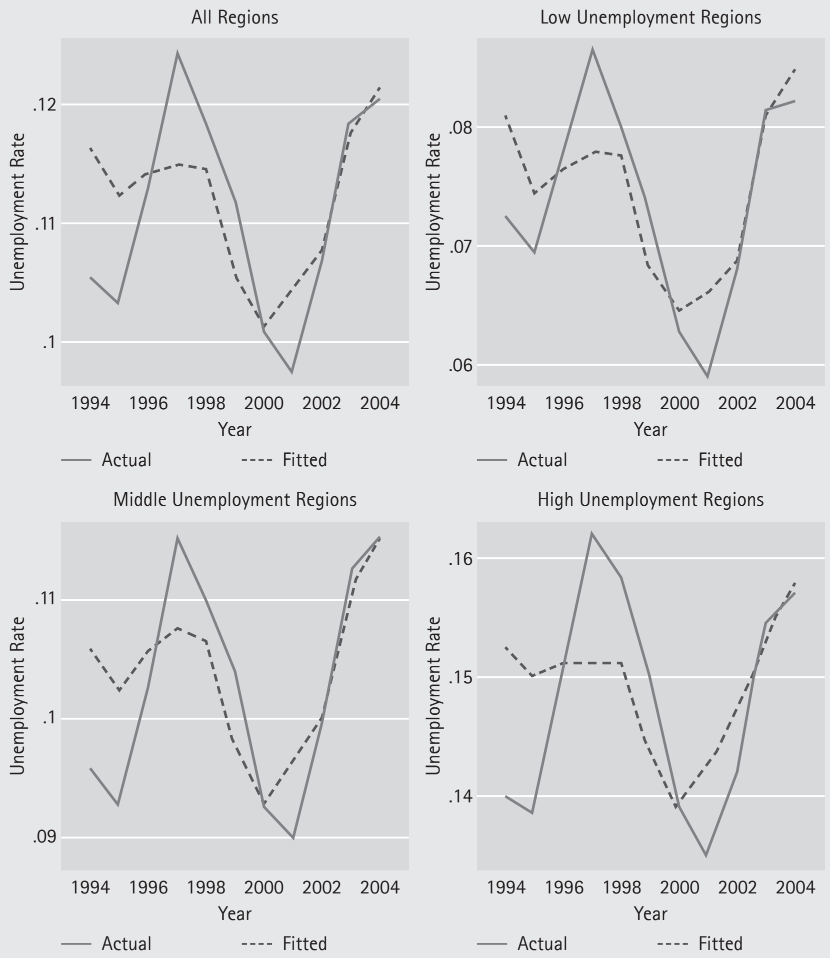
Figure 20: Distribution of low, middle and high unemployment districts



The figure shows that the distribution of low, middle and high unemployment regions in the year 1992 clearly forms clusters: low unemployment regions can be found primarily in southern Germany, middle unemployment regions in the central northern part and high unemployment regions on the boarders to East Germany, France, Denmark and the Netherlands.

The estimation of (46) and all further calculations were also carried out separately for high, middle and low unemployment regions. The estimation results of equation (46) for these subsets can be found in the Appendix. Actual and fitted values of the unemployment rate according to the estimated models for all, low, middle and high unemployment regions in the period 1994–2004 can be seen in Figure 21:

Figure 21: Actual and fitted unemployment rate of all, low, middle and high unemployment regions in the period 1994–2004



Generally, the development of the unemployment rate was very similar for all districts and the different subsets during the observation period. The unemployment rate in West German districts increased from 1995–1997, decreased afterwards until 2001 and rose again in the period 2001–2004. Thus, the observation period covers one economic cycle with a boom period from 1997–2001 and a recession period from 2001–2004. The levels for the different subsets were instead different. Low unemployment regions fluctuated around a mean of about 7 percent, middle unemployment regions around 10 percent and high unemployment regions around 15 percent. As can be seen in Figure 21, all estimated models are able to capture the specific time path that the unemployment rate underwent during this period.

In the following section, the estimation results are used to derive adjustment dynamics of the unemployment rate in the aftermath of a labour demand shock. For the dependent variables we calculate the adjustment paths after a one-off unit shock in labour demand, i.e. the employment growth rate. We measure the effect that changes in each exogenous variable had on the unemployment rate separately for the boom years 1997–2001 and the recession period of 2001–2004.

5.4.2 Labour demand shocks

In section 5.1 we argued, that labor market shocks are felt through time. This means that the effect of a shock in one single year is transported through different lagged adjustment mechanisms and is therefore also present in the following years. The question then is, how large the effect of a labour demand shock is first, directly in the aftermath of the shock and second, in total. In the CRT, the adjustment process after the occurence of a shock in period t is called unemployment persistence. It is defined as

$$\sigma \equiv \sum_{j=1}^{\infty} R_{t+j} \qquad \textbf{(48)}$$

where σ measures the effect of unemployment persistence for all periods $t + j$, $j \geq 1$ following the shock. Then, the series R_{t+j} denotes the impulse response function (IRF) of unemployment. In other words, unemployment persistence is simply the sum of all deviations from the initial unemployment rate at time t that are due to the shock. It covers the reactions in the system after the occurrence of a shock in period t. Economically, σ can be thought as additionally unemployed in the labour market after a shock trying to find a new job. The duration until these unemployed are back in employment may last several years. If equation (48) is dynamically stable,[28] the shock dies out gradually and converges towards its initial level. Then, unemployment persistence equals a finite quantity. If unemployment instead remains on a higher (lower) than the initial value, unemployment displays hysteresis and $\sigma = \infty$. In this case the shock leaves a permanent effect in the unemployment rate, meaning that not all unemployed get a new job again.

The total effect of the shock can then be characterized by the sum of the initial response R_t (the direct effect of the shock itself) and the unemployment persistence σ. The immediate response of unemployment can be interpreted as short-run elasticity, see Bande/Karanassou (2007). Then, the total effect equals

$$R_t + \sigma = \sum_{j=0}^{\infty} R_{t+j} \tag{49}$$

and can be characterized as long-run elasticity of unemployment with respect to the shock.

Mathematically, our measure of unemployment persistence can be calculated from the above estimation results by solving the system of equations represented in equation (46) for the unemployment rate as outlined in Bande/Karanassou (2007). The reduced form unemployment rate then equals a polynomial equation of the form

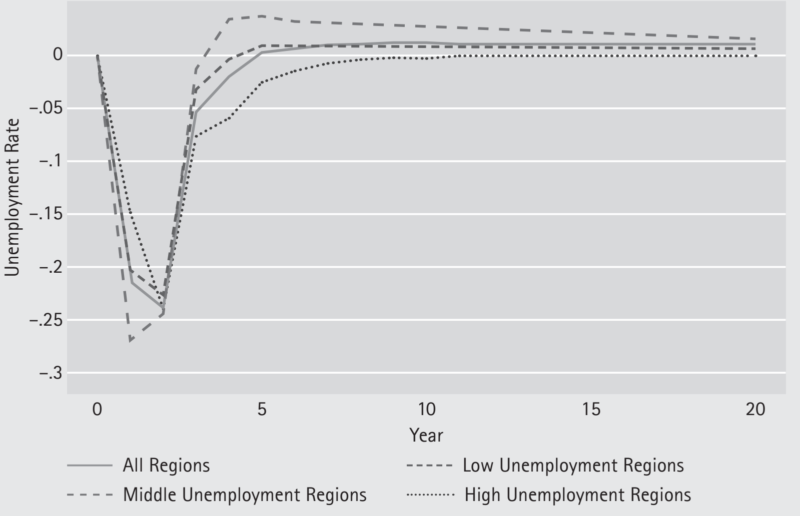
$$\rho(L)u_{it} = b(L)x_{it} + c(L)z_t + \theta_d(L)\varepsilon_{it}^{n} + \theta_w(L)\varepsilon_{it}^{w} + \theta_s(L)\varepsilon_{it}^{l} \tag{50}$$

where u_{it} is the regional unemployment rate, x_{it} is a 3x1 vector of regional exogenous variables and the 4x1 vector z_{it} contains the national variables. ε_{it}^{n}, ε_{it}^{w}, and ε_{it}^{l} are the error terms (residuals) and can be calculated from the labour demand/supply, wage setting and unemployment equations. $\rho(L)$, $b(L)$, $c(L)$, $\theta_d(L)$, $\theta_w(L)$, and $\theta_l(L)$ are functions of the estimated coefficients given in Table 13.

To visualize the effect of a labour demand shock on the unemployment rate, we calculate the according impulse response function for all as well as for low, middle and high unemployment regions separately. According to Bande/Karanassou (2007) and Decressin/Fatás (1995) we construct the shock as one-off unit shock in labour demand. The impulse response functions for the shocks are displayed in Figure 22:

28 The coefficients of the lagged unemployment rate must be lower than unity.

Figure 22: Unemployment responses of all, low, middle and high unemployment regions to a shock in labour demand



The response of the unemployment rate to a shock in labour demand is very similar in all different settings: the shocks do not lead to a permanent increase of the unemployment rate. They decrease rapidly after the occurrence of the shock. The major part of the initial shock has disappeared after two years and is completely absorbed by the system within approximately four years. In the year of the shock, the effect varies between 0.16 percentage points (high unemployment regions) and 0.27 percentage points (middle unemployment regions). In the estimation with all districts, the effect amounts to 0.22 percentage points. These values are comparable to the estimation results obtained for the Blanchard/Katz (1992) model in section 4 in the period 1989–2004. The base results of section 4 were that the unemployment rate returns to its initial value already in the period after a labour demand shock and decreases the unemployment rate by 0.21 percentage points in the year of the shock. Thus, a labour demand shock does not leave permanent effects on the unemployment rate and converges rapidly towards its initial level.

Next, we calculate short-run elasticity, persistence and long-run elasticity of a positive labour demand shock with respect to the unemployment rate according to equations (48) and (49). The results are displayed in Table 14:

Table 14: Short- and long-run effects of a labour demand shock in all, low, middle and high unemployment regions

Regions	All	Low	Middle	High
Short-run elasticity (R_0)	−0.22	−0.20	−0.27	−0.16
Persistence (σ)	−0.17	−0.14	+0.15	−0.46
Long-run-elasticity (R_t)	−0.39	−0.34	−0.12	−0.62

According to the estimates, a labour demand shock displays a long-run elasticity lower than unity in all combinations. This result shows that the unemployment rate is "underresponsive" in the sense that the initial labour demand shock is not fully reflected in the unemployment rate – also in the long-run. Approximately half of the shock is felt in the initial period, whereas the rest is felt in future periods – mainly in the period after the shock. Thus, labour demand shocks are not characterised by substantial unemployment persistence. The differences between low, middle and high unemployment regions are present but moderate. As expected, high unemployment regions show the lowest long-run elasticity to a positive labour demand shock. But, as they show the highest persistence, a positive labour demand shock displays the strongest long-run elasticity for high unemployment regions. Thus, high unemployment regions are not hit as severe as low and middle unemployment regions initially, but the shock is more persistent in future periods.

The most important findings from sections 5.4.1 and 5.4.2 are the following:

The simultaneous labour market model estimated for all West German districts as well as for low, middle and high unemployment districts separately shows a good fit of the movements in the unemployment rate for the period 1992–2004. The coefficients of the exogenous variables in the models are prevailingly compatible to the expected signs and the results are quite similar across the different settings. The unemployment rate is "underresponsive" to a labour demand shock in the long-run as not the full size of the shock is reflected in the unemployment rate. The shock does not leave permanent effects on the unemployment rate, i.e. the unemployment rate does not exhibit hysteresis effects and disappears completely within approximately four years. Approximately half of the total unemployment response is felt in the contemporaneous period, the rest of the effect in future periods – mainly in the period after the shock. The long-run elasticity of the shock is different across low, middle and high unemployment regions. As expected, high unemployment regions are not hit as severe as low and middle unemployment regions initially, but the shock is more persistent in future periods. This is an important result especially for politicians, as is supposes, that a positive one-off unit employment shock has the largest long-run effect on the unemployment rate of high unemployment regions.

5.4.3 Exogenous shocks

In the previous section the focus was to explore the adjustment of the unemployment rate after the occurence of a labour demand shock, i.e the shock in an endogenous variable of the system. In this section instead, the focus is on shocks in the exogenous variables. More precisely, we measure the impact of each exogenous variable in the absence of all other shocks by the direct and indirect effects on the unemployment rate over time.

To observe this, a concept to measure the total effect of actual exogenous shocks has to be applied to be able to separate the effects of shocks from different variables. This concept is developed similar to the concept already demonstrated for the measurement of unemployment persistence and is applied for each exogenous variable in each period. The total effect of all shocks of the respective variable, $\sum_{t=1}^{T} \tilde{R}_t$, can be measured by the sum over all its shocks in each period and is then given by[29]

$$\sum_{t=1}^{T} \tilde{R}_t = \sum_{t=1}^{T} \sum_{j=1}^{t} R_{tj} \tag{51}$$

where R_{tj} denotes the response of unemployment in period t to the jth shock. Thus, $\sum_{t=1}^{T} \tilde{R}_t$ is just the sum of all direct and indirect effects that each shock of the respective variable has on the unemployment rate. If $\sum_{t=1}^{T} \tilde{R}_t$ equals zero then the respective variable has no influence on the unemployment rate.

As the influence of the exogenous variables might be different in boom and recession periods, we calculate the impact on the unemployment rate for each variable separately for the boom period 1997–2001 and for the recession period 2001–2004. Additionally, figures are again calculated for all as well as for low, middle and high unemployment regions. The results for each exogenous variable and the summarized effect of regional (reg_t), national (nat_t) and all (all_t) exogenous variables can be seen in Table 15:

29 For a detailed description of the measure for the total effects of the shocks confer Bande/Karanassou (2007).

Table 15: Effects of exogenous shocks for boom and recession years

Region	inv_t	int_t	oil_t	$cons_t$	gdp_t	$prod_t$	pop_t	reg_t	nat_t	all_t
Boom period 1997–2001										
All	–0.23	–0.04	0.14	0.18	0.00	0.00	0.02	0.02	0.05	0.07
Low	–0.18	–0.06	0.08	0.08	–0.02	0.00	0.03	0.01	–0.07	–0.05
Middle	–0.24	0.08	0.15	0.19	0.01	0.00	0.03	0.03	0.17	0.21
High	–0.22	–0.07	0.18	0.25	0.02	–0.01	0.02	0.02	0.13	0.15
Recession period 2001–2004										
All	0.12	0.09	–0.02	–0.02	0.05	0.01	–0.01	0.04	0.18	0.22
Low	0.08	0.18	–0.04	–0.02	0.05	0.00	0.01	0.06	0.20	0.26
Middle	0.11	–0.02	0.06	–0.03	0.03	0.00	–0.03	0.01	0.11	0.12
High	0.15	0.13	0.00	–0.02	0.02	0.01	–0.01	0.03	0.25	0.28

In the boom period 1997–2001, the exogenous variables under consideration raised the unemployment rate by 0.07 percentage points. As the actual (fitted) unemployment rate decreased by 2.66 (1.04) percentage points during this period, this means that the exogenous variables do not capture the movements of the unemployment development. In the recession period of 2001–2004 the exogenous variables raised the unemployment level by 0.22 percentage points, although the actual (fitted) unemployment rate increased by 2.29 (1.75) percentage points. This means that the exogenous variables capture a share of approximately 10 percent (13 %) of the actual (fitted) unemployment development during the recession period. The different regional settings show only little differences: different to middle and high unemployment regions, low unemployment regions have profited from the development of exogenous variables during the boom period. In the recession period there were almost no differences between low and high unemployment regions.

The differentiation between regional and national exogenous variables shows that the effects of national variables were much higher than those of regional variables especially during recession years. This is a possible explanation for the fact that regions tend to parallel the national unemployment rate, see Figure 1, Figure 15 or Figure 21, which is also statistically stated in the strong cyclical sensitivity of regions and districts in section 3. In the boom period, the unemployment rate of low unemployment regions decreased by 0.07 percentage points through the development of national exogenous factors, whereas the same set of variables raised the unemployment rate of high unemployment regions by 0.20 percentage points. In the recession period, low unemployment regions denoted a slightly lower upward shift than high unemployment regions. Taken the whole effect of national exogenous variables over the period 1997–2004, high unemployment regions had to denote nearly three times the upward effect (0.38 percentage points) compared to low unemployment regions (0.13 percentage points). The impact of regional exogenous factors on the unemployment rate was small and quite similar across low, middle and high unemployment regions in boom as well as in recession years.

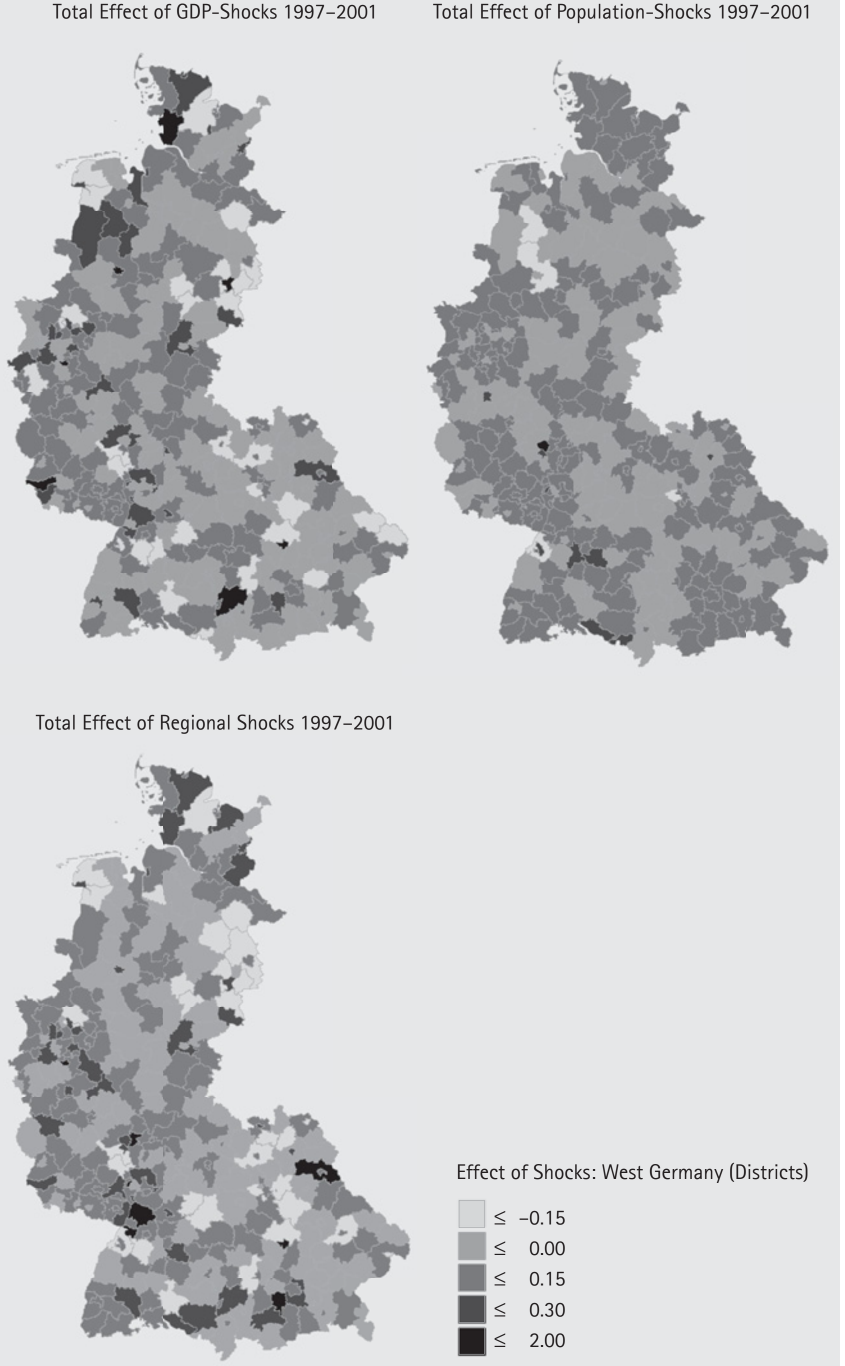
These observations suggest the following conclusion: in contrast to high unemployment regions, low unemployment regions profited disproportionally of national developments in the boom period and were hit only not as severe as high unemployment regions during recession periods. Regional factors instead do not seem to have a strong influence on the unemployment rate of the different region types.

The strongest influence on the unemployment rate had the national investment growth rate. On average, its development lowered the unemployment rate by 0.23 percentage points during the boom period and raised the unemployment rate by approximately half this amount (0.12 percentage points) during the recession years. The interest rate also caused a decrease of the unemployment rate of 0.04 percentage points on average during the boom years and caused an upward pressure of 0.09 in the recession period. For both variables, the effects for the different regional settings (i.e. low, middle and high unemployment regions) were not too distinct, but especially the investment growth rate had a stronger pushing, i.e. positive effect for high unemployment than for low unemployment regions in the recession period from 2001–2004. The development of the public consumption expenditure as well as the oil price growth rate had instead considerable upward effects on the unemployment rate from 1997–2001 but almost no effects from 2001–2004. Additionally, the pushing effects of both variables were weaker for low unemployment regions (0.16 percentage points) but amounted to 0.43 percentage points for high unemployment regions. To sum up, during the years 1997–2001, the development of oil prices and public consumption expenditure lead to a better unemployment development in low than in high unemployment regions. In the recession period from 2001–2004, additionally the development of investment figures contributed to a better development of low unemployment regions. This means that the growth rate of the public consumption expenditure and the oil prices during boom and the growth rate of investment figures during recession years were responsible for raising spatial differences between low and high unemployment rates in the period 1997–2004.

Among the regional variables, gdp and the population development had low effects on the unemployment rate. The effects of changes in real productivity were almost zero. On average, gdp movements had no effects during the boom period and lead to an increase of 0.05 percentage points from 2001–2004. The corresponding effects of the population development amounted to 0.02 in boom and –0.01 percentage points in recession years.

As seen above, regional variables did not have as large effects as national variables on the aggregate unemployment rate. But, as the development of these variables differs among each regional unit, the total effects are different for each district. As we have estimated equation (46) separately for low, middle and high unemployment regions, the coefficients also vary depending on the affiliation to the respective unemployment group. Therefore, the regional effects vary because of the different development of the respective exogenous variable as well as because of different coefficients and show considerable variation across districts. The total effect of actual shocks of regional variables are visualised in maps separately for the boom and recession years. As the effects of productivity shocks vary only within a span of –0.12 to 0.15, we do not show a separate map for productivity. The effects of gdp and population shocks as well as for all regional shocks during the period 1997–2001 are displayed in Figure 23:

Figure 23: Total effect of regional variables at district level (1997–2001)



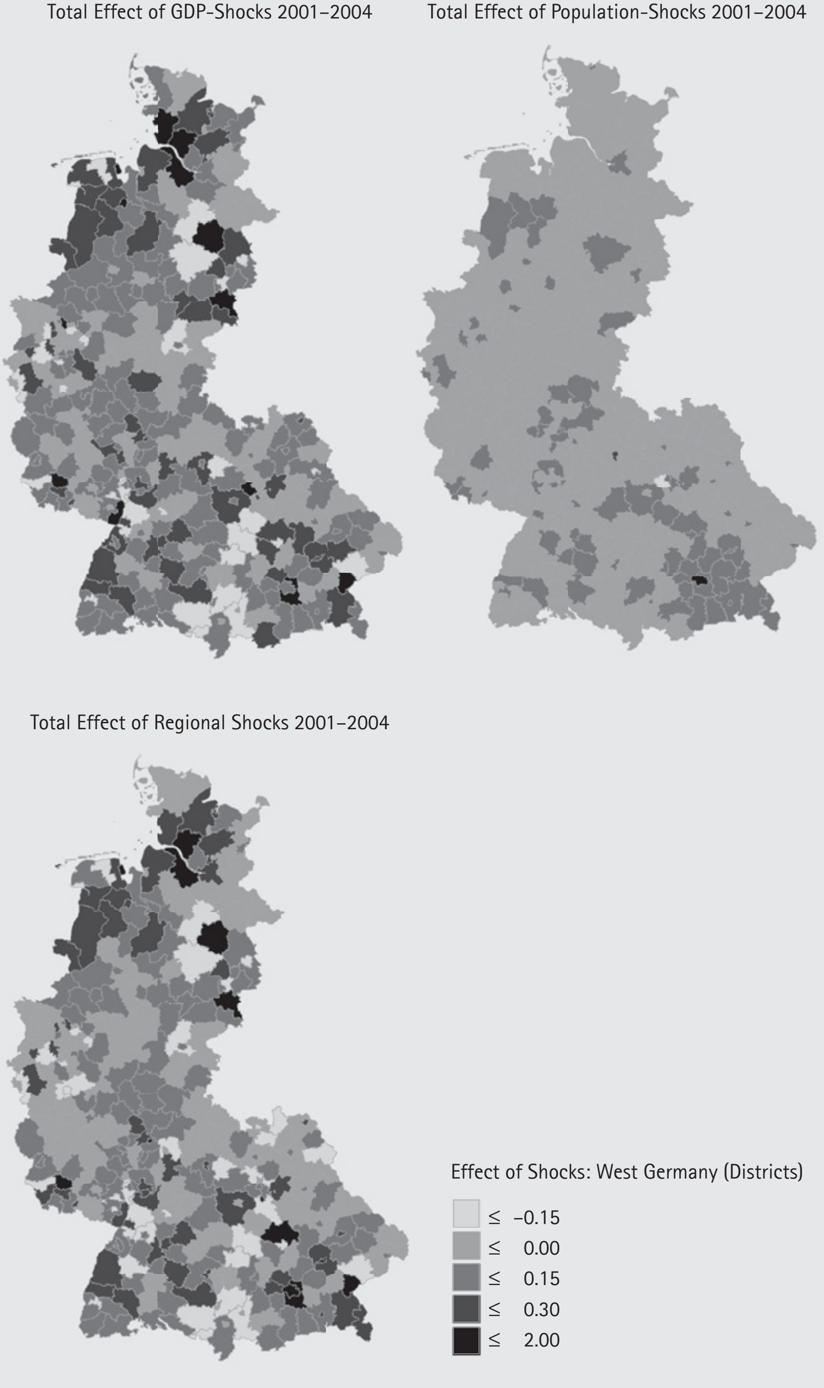
In the half of all districts (164), the boom period 1997–2001 was characterized by positive gdp shocks, i.e. those districts suffered of a weak gdp development increasing their unemployment rate. But, in most of them (157 districts), the effect was in a range between 0 and 0.3 percentage points. From the 162 districts that could denote a decrease in the unemployment rate, only 32 districts profited by a decrease below 0.15 percentage points. Districts with the highest negative effects can be found primarily in Bavaria and Lower-Saxony. The strongest negative effect on the unemployment rate was measured in the district Fürth (Bavaria), where changes in the gdp growth rate lowered the unemployment rate by 0.64 percentage points. The city district Ingolstadt (Bavaria) suffered under the highest rise of the unemployment rate by 0.66 percentage points.

Changes in the population growth rate had positive effects in nearly 2/3 of all districts. The range of the total effect varied between –0.43 in the district Fürth (Bavaria) to 0.32 percentage points in the Hessian state capital Wiesbaden. The highest positive effects of the population development during the boom period can be found in southern German districts. Negative effects through the population development can be found all over the country, but especially in Lower-Saxony, most districts the unemployment rate was instead relieved by the population development.

The regional distribution of the total effect of all regional variables (including the effects of real productivity) is correlated strongly with the pattern already found for the gdp development as this is the strongest effect of all regional variables. The overall loser and the overall winner districts thereby often show effects with the same sign for the gdp as well as the population growth rate. As Fürth (Bavaria) could denote the strongest negative effect from both, gdp as well as population shocks, it also had the strongest negative total effect in the boom period 1997–2001. Approximately 60 percent of the total negative effect of 1.06 percentage points was caused through gdp shocks and 40 percent through population shocks. The effect of productivity was negligible. The largest positive effect caused through the development of regional variables was found in the city district of Ingolstadt (Bavaria) with 0.52 percentage points. As already seen above, gdp shocks caused a rise in the unemployment rate of 0.66 percentage points which could be lowered by 0.14 percentage points through the development of population (–0.02 percentage points) and productivity (–0.12 percentage points).

The according effects for the recession period 2001–2004 can be seen in Figure 24:

Figure 24: Total effect of regional variables at district level (2001–2004)



The recession period 2001–2004 was characterized by rising unemployment caused through even stronger gdp shocks than in the boom period 1997–2001. In roughly 63 percent of all districts, the unemployment rate increased due to the bad gdp development during this period. Despite this development, 35 districts – predominantly those with a high unemployment rate in 1992 – could denote a negative effect below –0.15 percentage points. The strongest negative effect on the unemployment rate was measured in the city district Heilbronn (Baden-Württemberg), where the unemployment rate decreased by 0.74 percentage points. Positive unemployment effects, i.e. a rise in unemployment, can be found primarily in the north of Germany (Schleswig-Holstein and Lower-Saxony) but also in parts of the German south (Bavaria and Baden-Württemberg). The district Altötting (Bavaria) had to denote the highest rise of all districts. In the district situated on the border to Austria, the unemployment rate increased by 0.61 percentage points through gdp shocks.

In the recession period 2001–2004, the effects of the population growth rate were negative in nearly 3/4 of all districts (240), while the other 86 districts denoted a rising unemployment rate caused through the population development. Nevertheless, those effects were not very strong and – nearly all of the population effects varied within a range of –0.15 and 0.15 percentage points. Again, only the district Fürth (Bavaria) could denote a lower effect of –0.20 percentage points. On the other end of the ranking, the capital city of Bavaria, Munich, denoted with 0.41 percentage points by far the highest effect of the population growth rate on the unemployment rate. Apparently and similar to the Bavarian capital city Munich, most of the low unemployment districts around the Bavarian capital city Munich had to manage with an upward pressure through population shocks from 1997–2001 and from 2001–2004.

As already detected above, the total effects of regional shocks in the recession years 2001–2004 at district level are mainly driven by the gdp development. Accordingly, the regional distribution of the total regional effect looks very similar to the distribution caused through the gdp development as described above. The city district Flensburg (Schleswig-Holstein) denoted the strongest decrease through regional shocks (–0.61) and the district with the highest increase of the unemployment rate through regional factors was Altötting (Bavaria) with a total regional effect of 0.56 percentage points.

Over the period 1997–2004, the strongest negative effect on the unemployment rate of –0.96 can be found in Fürth (Bavaria). The district with the highest increase through regional factors is Munich (Bavaria) with a total regional effect of 0.69 percentage points.

The most important results from section 5.4.3 are the following:

The effects of national variables were much higher than those of regional variables especially during recession years. This is a possible explanation for the fact that regions tend to parallel the national unemployment rate. Investment figures had the strongest influence among all variables. The effect of productivity was instead negligible. All other variables displayed moderate to weak effects. The differentiation between low, middle and high unemployment regions shows that low unemployment regions profited disproportional from national developments in the boom period and were hit only weaker compared to high unemployment regions during recession periods. Regional factors instead do not seem to have a strong influence on the unemployment rate of the different region types.

Despite the quite low aggregate effects of regional variables, the results of the districts-specific calculations show that those effects are important at district level. The gdp growth rate turned out to have the strongest contributions to the regional effects during both, boom as well as recession years. The effects of the population growth rate were moderate, those of productivity to the largest part negligible. The composition of the total regional effects at district level shows that districts are very differently affected by each single regional variable. But, districts with the strongest negative (winner) and positive (loser) effects of regional variables thereby often show effects with the same sign for all exogenous variables.

5.5 Conclusions from the chain reaction theory

The simultaneous labour market model for West German districts gives some valuable insights for the explanation of movements in the unemployment rate during the period 1992–2004: unemployment movements are generated together by lagged adjustment processes and by exogenous shocks.

Adjustment processes to labour market shocks are transient and do not display hysteresis effects. The unemployment rate is "underresponsive" to a labour demand shock in the long-run as not the full size of the shock is reflected in the unemployment rate. The major part of the initial labour demand shock has disappeared after two years and is completely absorbed by the system within approximately four years. Approximately half of the shock affects the unemployment rate in the contemporaneous period the other half is due to temporal persistence in future periods, i.e. lagged adjustment effects. The long-run elasticity of the shock is different across low, middle and high unemployment regions. As expected, high unemployment regions are not hit as severe as low and middle unemployment regions initially, but the shock is more persistent in future periods.

The effects of national exogenous variables are much higher than those of regional exogenous variables especially during recession years. This is a possible explanation for the fact that regions tend to parallel the national unemployment rate. Investment figures have the strongest influence among all national variables. The differentiation between low, middle and high unemployment regions shows that low unemployment regions profited disproportional from national developments in the boom period and were hit only weaker compared to high unemployment regions during recession periods.

Despite the quite low aggregate effects of regional variables, the results of the districts-specific calculations show that those effects are important at district level. The gdp growth rate turned out to have the strongest contributions to the regional effects. In contrast to national factors, regional factors do not seem to have an influence on the disparities betwen low, middle and high unemployment districts.

6 Conclusion

The research on regional adjustment is based on a broad body of theoretical and empirical literature. The latest developments in geographical economics bear interesting implications for the development of regional disparities, but most geographical economics models do not consider unemployment. Only a few attempts that incorporate unemployment can be found in the recent literature. In a nutshell, they report that in the sort-run unemployment seems to rise in core regions as economic integration increases. The reason for this is supposed to be the direct effect of immigration on the labour force, where immigrants initially raise the pool of job-seekers and some frictions on the labour market avoid instant integration. In the long-run, however, unemployment in core regions rather decreases with increasing economic integration and disparities between core and periphery seem to widen rather than to narrow as predicted in the neoclassical literature. Unfortunately, the few approaches that consider unemployment are hard to test empirically.

Another paper on regional evolutions – the paper of Blanchard/Katz (1992) – presents an elaborate regional labour market model that explicitly deals with the adjustment of unemployment in the aftermath of a shock. This paper found broad acceptance in the international regional science literature. Therefore, this approach is chosen to analyse regional adjustment of German federal states and districts. As many studies simply adopt the empirical approach of Blanchard/Katz (1992) with respect to the main characteristic features, we review the recent international research results based on their model. International research results can be characterized as follows with respect to the kind and duration of labour market adjustment:

The US adjustment after an adverse shock to labour demand is mainly driven by interregional migration and only partly via the unemployment and the participation rate. Adjustment to a region-specific labour demand shock in Europe is instead mainly via the participation rate, partly via the unemployment rate but hardly via migration. The time span until the adjustment of the unemployment and the participation rate has completely settled is however faster in Europe than in the US – i.e. the unemployment and the participation rate return faster towards their initial value in Europe than in the US.

Within Europe, results for northern, central and southern European countries are quite homogenous. If ever, one might suppose that southern European countries have a higher share in the adjustment mechanism via the unemployment rate compared to central and northern European countries. Additionally the speed of adjustment of the unemployment/participation rate towards the steady state seems to be lower in southern European countries.

Labour market adjustment in the Australasian countries Australia and New Zealand is quite different and should not be lumped together. The Australian labour market adjusts quite rapidly to labour demand shocks – mainly via the participation rate and migration. The estimated shares and durations range between the values found in Europe and the US. Labour market adjustment in New Zealand is instead quite slow and predominantly driven by changes in the unemployment rate.

The empirical part of the paper takes up the problem of strongly persistent unemployment disparities in Germany at a small regional level. Unemployment rates display an enormous range across the country but hardly vary over time for most of the districts. Thus, the distribution of unemployment rates at district level in Germany exhibits strong persistent behaviour. The relative distribution seems to be even more persistent than those of absolute values. These findings are similar to those found for most European countries but contrast sharply with those for the US, where unemployment rates are hardly persistent.

For Germany, regional differences in the unemployment rate are in a first step analysed by univariate time-series methods to see, if unemployment rates display convergence or divergence. We obtain the following results:

Panel unit root tests indicate that both the absolute and the relative unemployment rates of regions and districts display convergence towards their region-specific means and therefore towards a stable distribution of regional unemployment disparities. This result is due to an adjustment mechanism that leads to a convergence of each spatial unit towards its steady-state unemployment rate. Thus, highly persistent regional unemployment disparities can be regarded as region-specific unemployment rates due to different regional endowments, adjusting quite rapidly to their region-specific means, but not towards the national unemployment rate.

The investigation of adjustment processes suggests that the degree of persistence in the absolute unemployment rates in western Germany has decreased markedly during the last decades. Thus, the results found by Decressin/Fatás (1995) are confirmed for the period 1966–1987 but are no longer valid for more recent years. Therefore, our conclusion is that neither aggregate nor region-specific shocks have been responsible for the persistent behaviour of unemployment rates in the last 16 years. This result also holds for districts. Therefore, slow-working adjustment mechanisms in response to shocks are not responsible for the persistent unemployment differentials.

Taking these results together, there is no tendency for differentials between spatial units that grew in earlier periods to decrease, although adjustment mechanisms performed well during the last decades. This is a strong indication that the stable distribution of unemployment rates found above remains stable for long periods of time.

Comparing the results obtained for regions and districts shows ambivalent results for panel unit root tests and impulse response estimates with respect to the adjustment duration. But, as all of the estimated half-lives – for both regions and for districts – are found to be very robust within a range from 1–3 years, our conclusion is that the adjustment processes of districts and regions do not differ markedly.

In a second step, the adjustment of the labour market to a labour demand shock is analysed by the trivariate empirical model inspired by Blanchard/Katz (1992) to measure the strength and speed of the adjustment paths of the employment level, the unemployment rate and the participation rate. The results for German Federal States and districts are in line with the recent literature. Estimates of shocks to labour demand at the place of residence suggest that adjustment to region-specific shocks in the first year is mainly through participation behaviour and unemployment changes, not by migration. But, as unemployment and participation rates return to their initial values already in the year after the shock, this suggests strong migration flows in the year after the shock. These results hold for Federal States as well as for districts. If, however, the estimates additionally allow for commuting as adjustment mechanism, the picture changes considerably: compared to the estimation at the place of residence, the unemployment rate and interregional mobility (i.e. migration and commuting activities) capture the major part of adjustment during the year of the shock. The participation rate in turn accounts for only a very small share. Thus, migration and commuting are highly relevant for the adjustment behaviour of districts as well as for Federal States. Again, the duration until the unemployment and the participation rate return to their initial values is only about one to two years. As this fast adjustment holds for all different estimates, slow working adjustment mechanisms in the aftermath of labour demand shocks are not responsible for persistent unemployment differentials.

Furthermore, the adjustment processes of districts and Federal States differ substantially with respect to the degree of openness: interregional mobility accounts for a significantly larger proportion of the adjustment process in the case of districts than on a larger regional level. Unemployment and participation rates in turn account for lower shares. Thus, the hypothesis that the adjustment process for smaller spatial units is much more reflected in interregional migration or commuting and less in changes in the unemployment and the participation rate, is confirmed.

Finally, an equilibrium approach with a system of equations introduced by Karanassou/Snower (2000) is estimated to measure the extent to which the unemployment rate is driven by changes in the endogenous and exogenous variables. The chain reaction theory (CRT) labour market model estimated for West

German districts gives some valuable insights for the explanation of movements in the unemployment rate during the period 1992–2004: both, lagged adjustment processes as well as exogenous shocks were responsible for unemployment movements.

Adjustment processes to labour market shocks are transient and do not display hysteresis effects. The unemployment rate is "underresponsive" to a labour demand shock in the long-run as not the full size of the shock is reflected in the unemployment rate. The major part of the initial labour demand shock has disappeared after two years and is completely absorbed by the system within approximately four years. Approximately half of the shock affects the unemployment rate in the contemporaneous period the other half is due to temporal persistence in future periods, i.e. lagged adjustment effects. The long-run elasticity of the shock is different across low, middle and high unemployment regions. As expected, high unemployment regions are not hit as severe as low and middle unemployment regions initially, but the shock is more persistent in future periods.

The effects of national exogenous variables are much higher than those of regional exogenous variables especially during recession years. This is a possible explanation for the fact that regions tend to parallel the national unemployment rate. Investment figures have the strongest influence among all national variables. The differentiation between low, middle and high unemployment regions shows that low unemployment regions profited disproportional from national developments in the boom period and were hit only weaker compared to high unemployment regions during recession periods.

Despite the quite low aggregate effects of regional variables, the results of the districts-specific calculations show that those effects are important at district level. The gdp growth rate turned out to have the strongest contributions to the regional effects. In contrast to national factors, regional factors do not seem to have an influence on the disparities betwen low, middle and high unemployment districts.

Overall the study shows several valuable findings and draws a detailed picture of regional adjustment in Germany:

Disparities in the regional unemployment rates in Germany are more distinct, the smaller the regional level of observation. Furthermore, the adjustment of smaller spatial units to labour market shocks is found to work predominantly through labour mobility and less through the unemployment and the participation rate. The speed of adjustment in the unemployment rate does instead not vary substantially between Federal States and districts. The distribution of regional unemployment rates thereby displays strong persistence and does not show convergence towards the national unemployment rate, but convergence towards the region-specific means. Labour market adjustment mechanisms work efficient as labour demand shocks disappear within only a few years. The estimates additionally show that substantial migration and commuting activities are responsible for this efficiency. The conclusion from these observations is that persistent disparities are due to differing regional endowments and display a stable distribution of regional unemployment rates.

This distribution is relocated by exogenous variables. National exogenous variables as investment figures, the interest rate or public consumption expenditures are mainly responsible for shifts of the distribution and explain the strong cyclical behaviour of regional unemployment rates. The major driving force turns out to be the investment growth rate. The distinction between low, middle and high unemployment regions additionally shows that national variables tend to increase differences between those types of regions, whereas regional variables as the population growth rate or the gdp development do not seem to have an influence. Therefore, a convergence process towards the national unemployment rate does not occur.

These results bear simple but well known advice for politics:

Obviously unemployment disparities can not be reduced by supporting interregional mobility. Migration and commuting activities are sufficiently large for an efficient labour market adjustment mechanism and should not be further strengthened. Thus, the argument that the US labour market works more efficient than the German one because of higher factor mobility – predominantly those of workers – is not relevant in context of regional unemployment disparities in Germany. If the aim of policy makers is to reduce regional unemployment disparities they must rather concentrate on improving the strength of regional high unemployment economies by raising their endowment with production factors, i.e. capital and/or people. The most efficient way would be to locally raise investment figures and/or public consumption expenditures. Positive investment shocks directly push the regional employment growth rate and thereby lower the unemployment rate. These dampening effects outweigh by far the pushing indirect effects on the unemployment rate caused through increasing wages which decrease the employment growth rate and the labour force growth rate and thereby increase the unemployment rate. The same argument holds for locally raising public consumption expenditures which increase the regional labour force growth rate and thereby decrease the regional unemployment rate. Another means to lower the regional unemployment rate of high unemployment regions is raising the local gdp or the (high-skilled) resident population. Those measures would increase the local employment growth rate and the labour force growth rate, respectively, and thereby cause the unemployment rate to decrease.

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Appendix

Chapter 4.4: Results of IPS and LLC Panel Unit Root tests for stationarity

Levin, Lin and Chu (LLC)					Im, Pesaran and Shin (IPS)			
Lags	Obs.	Coeff.	t_{star}	$P > t_{star}$	Lags	Obs.	$W(t_{bar})$	$P > t_{bar}$
Regional relative (β-corrected) employment growth rate								
Districts, 1989–2004, Place of work								
0	4890	−0.812	−38.465	0.000***	0	4890	−30.121	0.000***
1	4564	−0.812	−40.055	0.000***	1	4564	−28.978	0.000***
2	4238	−0.812	−41.645	0.000***	2	4238	−30.080	0.000***
Districts, 1989–2004, Place of residence								
0	4890	−0.868	−44.375	0.000***	0	4890	−33.649	0.000***
1	4564	−0.868	−45.971	0.000***	1	4564	−32.349	0.000***
2	4238	−0.868	−47.568	0.000***	2	4238	−33.345	0.000***
Regional relative (β-corrected) employment rate								
Districts, 1989–2004								
0	4890	−0.370	−8.494	0.000***	0	105	−8.297	0.000***
1	4564	−0.370	−10.389	0.000***	1	98	−8.115	0.000***
2	4238	−0.370	−12.284	0.000***	2	91	−9.500	0.000***
Regional relative (β-corrected) participation rate								
Districts, 1989–2004								
0	4890	−0.482	−13.279	0.000***	0	4890	−11.228	0.000***
1	4564	−0.482	−15.216	0.000***	1	4564	−10.942	0.000***
2	4238	−0.482	−17.153	0.000***	2	4238	−12.247	0.000***
*, **, *** significant at the 10, 5 and 1 percent levels respectively.								

Chapter 5.4.1:

Estimation Results for low unemployment districts

Labour demand: Δn_{it}		**Wage setting: Δw_{it}**		**Labour supply: Δl_{it}**		**Unemployment rate: $urate_{it}$**	
Var.	Coeff.	Var.	Coeff.	Var.	Coeff.	Var.	Coeff.
$L\Delta n_{it}$	0.116***	Δn_{it}	–0.124***	Δn_{it}	0.015	Δn_{it}	–0.196***
$L2\Delta n_{it}$	0.083***	$L\Delta w_{it}$	–0.437***	$L\Delta n_{it}$	0.081***	$L\Delta n_{it}$	–0.165***
Δw_{it}	–0.192***	$urate_t$	0.596***	Δw_{it}	–0.021*	Δl_{it}	–0.401***
$L\Delta w_{it}$	–0.272***	$Lurate_t$	–0.628***	$L\Delta w_{it}$	–0.066***	$L\Delta l_{it}$	–0.009
Δgdp_{it}	0.140***	$\Delta prod_t$	0.008	$L\Delta l_{it}$	–0.107***		
$L\Delta gdp_{it}$	0.064***	$L\Delta prod_t$	0.003	$L2\Delta l_{it}$	0.060**		
Δoil_t	0.002	Δint_t	0.888***	Δpop_{it}	0.305***		
$L\Delta oil_t$	–0.006***	$L\Delta int_t$	0.586***	$L\Delta pop_{it}$	0.448***		
Δinv_t	–0.047***	Δinv_t	0.206***	Δint_t	0.632***		
$L\Delta inv_t$	0.216***	$L\Delta inv_t$	–0.052**	$L\Delta int_t$	0.295***		
				$cons_t$	0.164***		
				$Lcons_t$	0.127***		
Obs.	1,090	Obs.	1,090	Obs.	1,090	Obs.	1,090
R^2	0.541	R^2	0.379	R^2	0.709	R^2	0.989
p-val.	0.000***	p-val.	0.000***	p-val.	0.000***	p-val.	0.000***

*, **, *** significant at the 10, 5 and 1 percent level.

Estimation Results for middle unemployment districts

Labour demand: Δn_{it}		Wage setting: Δw_{it}		Labour supply: Δl_{it}		Unemployment rate: $urate_{it}$	
Var.	Coeff.	Var.	Coeff.	Var.	Coeff.	Var.	Coeff.
$L\Delta n_{it}$	0.156***	Δn_{it}	–0.227***	Δn_{it}	0.019	Δn_{it}	–0.263***
$L2\Delta n_{it}$	0.042	$L\Delta w_{it}$	–0.545***	$L\Delta n_{it}$	0.096***	$L\Delta n_{it}$	–0.164***
Δw_{it}	–0.365***	$urate_{t}$	0.445***	Δw_{it}	–0.105***	Δl_{it}	–0.359***
$L\Delta w_{it}$	–0.393***	$Lurate_{t}$	–0.519***	$L\Delta w_{it}$	–0.106***	$L\Delta l_{it}$	–0.140***
Δgdp_{it}	0.080***	$\Delta prod_{t}$	0.006	$L\Delta l_{it}$	–0.214***		
$L\Delta gdp_{it}$	0.052***	$L\Delta prod_{t}$	0.028**	$L2\Delta l_{it}$	0.130***		
Δoil_{t}	0.009***	Δint_{t}	1.113***	Δpop_{it}	0.295***		
$L\Delta oil_{t}$	–0.006***	$L\Delta int_{t}$	0.578***	$L\Delta pop_{it}$	0.301***		
Δinv_{t}	–0.031*	Δinv_{t}	0.214***	Δint_{t}	0.818***		
$L\Delta inv_{t}$	0.210***	$L\Delta inv_{t}$	–0.032	$L\Delta int_{t}$	0.141***		
				$cons_{t}$	0.262***		
				$Lcons_{t}$	0.270***		
Obs.	1,090	Obs.	1,090	Obs.	1,090	Obs.	1,090
R^2	0.498	R^2	0.397	R^2	0.583	R^2	0.992
p-val.	0.000***	p-val.	0.000***	p-val.	0.000***	p-val.	0.000***

*, **, *** significant at the 10, 5 and 1 percent level.

Estimation Results for high unemployment districts

Labour demand: Δn_{it}		Wage setting: Δw_{it}		Labour supply: Δl_{it}		Unemployment rate: $urate_{it}$	
Var.	Coeff.	Var.	Coeff.	Var.	Coeff.	Var.	Coeff.
$L\Delta n_{it}$	0.144***	Δn_{it}	–0.021	Δn_{it}	0.119***	Δn_{it}	–0.125***
$L2\Delta n_{it}$	0.213***	$L\Delta w_{it}$	–0.534***	$L\Delta n_{it}$	0.067***	$L\Delta n_{it}$	–0.189***
Δw_{it}	–0.156***	$urate_{t}$	0.322***	Δw_{it}	–0.040***	Δl_{it}	–0.294***
$L\Delta w_{it}$	–0.248***	$Lurate_{t}$	0.420***	$L\Delta w_{it}$	–0.058***	$L\Delta l_{it}$	–0.127***
Δgdp_{it}	0.112***	$\Delta prod_{t}$	0.036***	$L\Delta l_{it}$	–0.146***		
$L\Delta gdp_{it}$	0.086***	$L\Delta prod_{t}$	0.056***	$L2\Delta l_{it}$	0.143***		
Δoil_{t}	0.006***	Δint_{t}	0.771***	Δpop_{it}	0.113**		
$L\Delta oil_{t}$	–0.013***	$L\Delta int_{t}$	0.273*	$L\Delta pop_{it}$	0.227***		
Δinv_{t}	–0.006	Δinv_{t}	0.162***	Δint_{t}	0.684***		
$L\Delta inv_{t}$	0.200***	$L\Delta inv_{t}$	–0.048**	$L\Delta int_{t}$	–0.103**		
				$cons_{t}$	0.291***		
				$Lcons_{t}$	0.400***		
Obs.	1,080	Obs.	1,080	Obs.	1,080	Obs.	1,080
R^2	0.493	R^2	0.326	R^2	0.668	R^2	0.993
p-val.	0.000***	p-val.	0.000***	p-val.	0.000***	p-val.	0.000***

*, **, *** significant at the 10, 5 and 1 percent level.

Abstract

Disparities in the regional unemployment rates in Germany are more distinct, the smaller the regional level of observation. Furthermore, the adjustment of smaller spatial units to labour market shocks is found to work predominantly through labour mobility and less through the unemployment and the participation rate. The speed of adjustment in the unemployment rate does instead not vary substantially between Federal States and districts. The distribution of regional unemployment rates thereby displays strong persistence and does not show convergence towards the national unemployment rate, but convergence towards the region-specific means. Labour market adjustment mechanisms work efficient as labour demand shocks disappear within only a few years. The estimates additionally show that substantial migration and commuting activities are responsible for this efficiency. The conclusion from these observations is that persistent disparities are due to differing regional endowments and display a stable distribution of regional unemployment rates.

This distribution is relocated by exogenous variables. National exogenous variables as investment figures, the interest rate or public consumption expenditures are mainly responsible for shifts of the distribution and explain the strong cyclical behaviour of regional unemployment rates. The major driving force turns out to be the investment growth rate. The distinction between low, middle and high unemployment regions additionally shows that national variables tend to increase differences between those types of regions, whereas regional variables as the population growth rate or the gdp development do not seem to have an influence. Therefore, a convergence process towards the national unemployment rate does not occur.

Kurzfassung

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Eine empirische Analyse der Determinanten und Anpassungspfade auf kleinräumiger Ebene

Die Unterschiede in den regionalen Arbeitslosenquoten in Deutschland sind umso ausgeprägter, je kleinräumiger die betrachteten Einheiten sind. Darüber hinaus findet die Anpassung von kleinräumigen Einheiten nach Arbeitsmarktschocks vorwiegend durch Arbeitskräftemobilität und weniger durch die Arbeitslosenquote bzw. die Partizipationsrate statt. Die Anpassungsgeschwindigkeit der Arbeitslosenquote unterscheidet sich dabei aber kaum zwischen Bundesländern und Kreisen. Die Verteilung der regionalen Arbeitslosenquoten zeigt dabei ausgeprägte Persistenz, weist aber keine Konvergenz gegen die nationale Arbeitslosenquote, sondern Konvergenz gegen die regionsspezifischen Mittelwerte auf. Die Anpassungsprozesse auf dem Arbeitsmarkt sind effizient, da Arbeitsnachfrageschocks innerhalb weniger Jahre verschwinden. Die Schätzungen zeigen zusätzlich, dass diese Effizienz durch erhebliche Migrations- und Pendlerströme bewirkt werden. Die Schlussfolgerung daraus ist, dass dauerhafte Disparitäten durch unterschiedliche regionale Ausstattungen bewirkt werden und daher eine stabile Verteilung regionaler Arbeitslosenquoten darstellen.

Diese Verteilung wird durch exogene Faktoren verschoben. Nationale exogene Faktoren wie Investitionsvolumina, Zinsniveau oder Staatsausgaben sind dabei vorwiegend für die Verschiebung der Verteilung verantwortlich und erklären dadurch das stark zyklische Verhalten regionaler Arbeitslosenquoten. Als Hauptursache stellt sich dabei die Wachstumsrate der Investitionen heraus. Die Unterscheidung zwischen Regionen mit niedriger, mittlerer und hoher Arbeitslosigkeit zeigt darüber hinaus, dass nationale Faktoren tendenziell zu einer Verschärfung der Disparitäten führen, wohingegen regionale Faktoren wie das Bevölkerungswachstum oder die Entwicklung des BIP hierauf scheinbar keinen Einfluss haben. Aus diesem Grund findet ein Konvergenzprozess gegen die nationale Arbeitslosenquote nicht statt.